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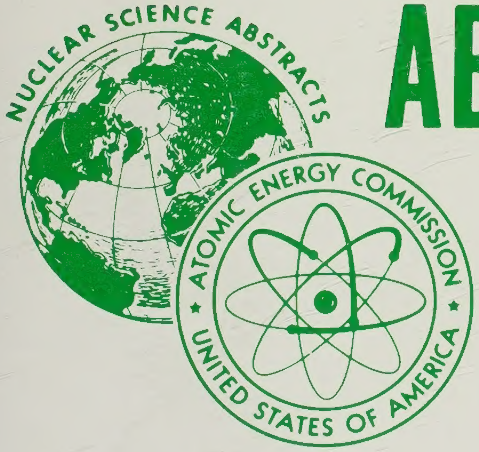
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ATOMIC ENERGY COMMISSION
UNITED STATES OF AMERICA

Volume 26 Number 15

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Volume 26, Number 15, August 15, 1972

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NEWLAND, E. A., Radiation treatment of sewage, 25:140 (AAEC/LIB/Bib-254)

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  separation by ion exchange and complex-formation elution, 25:251(P)

TRIETHYLENETETRAMINE
  complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
  content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
  content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
  determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
  Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

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CHEMISTRY

Analytical Chemistry

Refer also to abstracts 36035, 36036, 36103, 36149, 36527, and 36528.

35760 ISOTOPE DILUTION ANALYSIS. Toelgyessy, J.; Braun, T.; Kyrs, M. Oxford; Pergamon Press (1972). 194p. £3.50.

The subject is reviewed under the following main headings: principles, types and theory of isotope dilution analysis; experimental techniques, separations, and determinations; inorganic applications; applications in organic chemistry and biochemistry; isotope dilution analysis with stable isotopes; and special applications of isotope dilution. (UK)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 35978 and 36313.

35761 (ORO–2670-47) RADIOCHEMISTRY AS APPLIED TO GEOCHEMICAL PROBLEMS: NEUTRON ACTIVATION ANALYSIS. Final Report. McDonald, James Y. (Kentucky Univ., Lexington. Research Foundation). 14 Jan 1972. Contract AT(40-1)-2670. 39p. Dep. NTIS.

The use of neutron activation for analysis of geochemical samples is discussed and reports on research in this area listed. (M.C.G.)

35762 (RISO–256, pp 143-61) SIMULTANEOUS DETERMINATION OF ARSENIC, MANGANESE, AND SELENIUM IN BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Heydorn, K.; Damsgaard, E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.

In Aspects of research at Risoe.

A new method was developed for the simultaneous determination of arsenic, manganese, and selenium in biological material by thermal-neutron activation analysis. The use of ^{81m}Se as indicator for selenium permitted a reduction of activation time to 1 hour for a one-gram sample, and a possible loss of volatile compounds during irradiation was avoided. No pre-treatment of the sample is required, and the radiochemical separation scheme is based on simple chemical operations, completed in less than 3 hours. The actual precision achieved in routine application of the method in the analytical laboratory was in good agreement with the calculated precision, and the results are therefore well suited for statistical evaluation of differences at the ppB level in samples of biological tissue. (auth)

35763 DETERMINATION OF URANIUM IN VARIOUS MATERIALS BY DELAYED NEUTRON COUNTING. Nass, H. W.; Molinski, V. J.; Kramer, H. H. (Union Carbide Corp., Tuxedo, N. Y.). Mater. Res. Stand.; 12: No. 4, 24-6(Apr 1972).

A delayed neutron counting method was adapted for routine determination of uranium in ores, sediments, metals and metal alloys, and biological specimens. The method is based on the measurement of the delayed neutron emission caused by the decay of fission products produced during fission of the nuclide. The specimen is irradiated in a neutron flux and the neutrons emitted are counted with BF$_3$ tube detectors embedded in a paraffin moderator. The analysis can be applied to any specimen type, and the routine application has reduced the cost sufficiently so that it is an attractive method for analyzing large numbers of specimens. The lower limit of detection for uranium of natural isotopic abundance is approximately 10^{-8} g. The precision of three to five determinations on one specimen ranges from 3 to 10 percent (relative standard deviation) at the ppM level. For specimens containing more than 0.1 ppM uranium, this method is one of the fastest and easiest analytical techniques. (auth)

35764 DETERMINATION OF GERMANIUM IN ORGANOGERMANIUM COMPOUNDS BY THE THERMAL NEUTRON ACTIVATION METHOD. Duda, I.; Obtemperanskaya, S. I.; Dudova, I. V. (Moscow State Univ.). Zh. Anal. Khim.; 27: No. 2, 373-9(Feb 1972). (In Russian).

The possibility was studied for determining germanium in organogermanium compounds of C, H, O, Ge composition by thermal neutron activation in a reactor. A teflon container was used. Determination was carried out using the ^{77}Ge isotope (T = 11.3 hr). The sensitivity is 10 μg if the impulse sum in the photopeak is 3 times as much as the square error of the phone measurement at the same part of the spectrum during the same measurement time. The square error of a single measurement does not exceed 0.64. (auth)

35765 CONTINUOUS ACTIVATION ANALYSIS OF FLOWING SOLUTIONS. II. DESIGN AND MODE OF OPERATION OF THE ANALYZER. Kliment, V. (Institut fuer Physik, Bratislava); Toelgyessy, J. Isotopenpraxis; 8: No. 1, 20-2(Jan 1972). (In German).

A laboratory unit for continuous activation analysis of flowing liquids was designed and erected. The unit comprises a storage tank for the sample solution, an activation chamber, a Pu–Be neutron source, a detector chamber, a detector attachment, a laboratory pump, and a flowmeter. Preliminary tests showed that the unit renders possible determination of vanadium, silver, and cobalt. (auth)

35766 SOURCES AND DISTRIBUTION OF VANADIUM IN THE ATMOSPHERE. Zoller, W. H.; Gordon, G. E.; Gladney, E. S.; Jones, A. G. Amer. Chem. Soc., Div. Water, Air Waste Chem., Gen. Pap.; 11: No. 2, 159-65(1971).

Atmospheric concentrations of vanadium can be measured by the use of lithium-drifted germanium gamma detectors in neutron activation analysis. The two largest potential natural sources of atmospheric vanadium are the oceans and continental land masses. Crustal weathering is another source of vanadium that must be considered. (Air Pollut. Abstr.)

35767 NEUTRON ACTIVATION ALAYSIS OF HIGH-PURITY TIN. CHEMICAL SEPARATIONS AND NUCLEAR INTERFERENCES. Maenhaut, W.; Adams, F.; Hoste, J. (Univ., Ghent). Anal. Chim. Acta; 59: No. 2, 209-15(Apr 1972).

Eighteen trace elements were determined in high-purity tin by reactor neutron activation analysis. For the determination of 16 elements, a distillation from a sulfuric acid–hydrobromic acid medium was applied. Tin, arsenic, selenium, and antimony were distilled, while the nonvolatile elements remained in the distillation residue. After measurement of the distillation residue with a Ge(Li) detector, 13 elements were determined. For the determination of arsenic, selenium, and antimony an additional separation from the tin activities was developed. Besides this distillation procedure, an anion-exchange method and an instrumental procedure were applied to determine indium and manganese in tin. (auth)

35768 DETERMINATION OF A CARBON IMPURITY IN BERYLLIUM BY A NONDESTRUCTIVE ACTIVATION METHOD.

Zadvornyi, A. S.; Gorenko, A. F.; Klyucharev, A. P.; Serykh, N. V.; Skakun, N. A. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 805-7(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 781-3(Sep-Oct 1971).

A method was developed for the direct determination of a carbon impurity by proton activation in materials whose matrices are not activated. The use of "equivalent thicknesses" was proposed for considering energy losses with depth of penetration. The methods permit nondestructive determination of the concentration of carbon in beryllium with sufficient sensitivity. The sensitivity of the method of "equivalent thicknesses" can be increased to 10^{-5}% if a proton beam from a cyclotron with a current of 10 μA is used. (auth)

35769 PHOTOACTIVATION ANALYSIS OF GALLIUM–NIOBIUM ALLOYS. Gedeonov, A. D.; Kuznetsov, R. A. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 808-9(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 783-4(Sep-Oct 1971).

Instrumental determination of Ga and Nb in Ga–Nb alloys by photon activation is discussed and the method described. (M.C.G.)

35770 N-BENZOYL-N-PHENYLHYDROXYLAMINE AS A SUBSTOICHIOMETRIC EXTRACTANT IN NEUTRON ACTIVATION ANALYSIS. VI. DETERMINATION OF MANGANESE IN STEEL. **Nadkarni, R. A.; Haldar, B. C. (Inst. of Science, Bombay). Radiochem. Radioanal. Lett.; 10: No. 2, 95-105 (14 May 1972).**

N-Benzoyl-N-phenylhydroxylamine (BPHA) was used for substoichiometric extraction of Mn(II) after thermal neutron activation of steel samples. The 1 : 2 Mn(II)–BPHA complex is extracted into chloroform at pH 10 to 11. The selectivity of the method is increased by preliminary separation of Mn(II) as MnO_2 with $KBrO_3$ precipitation. (auth)

35771 SENSITIVITY VERSUS TARGET BACKINGS FOR ELEMENTAL ANALYSIS BY ALPHA EXCITED X-RAY EMISSION. **Flocchini, R. G.; Feeney, P. J.; Sommerville, R. J.; Cahill, T. A. (Univ. of California, Davis). Nucl. Instrum. Methods; 100: No. 3, 397-402(1972).**

The sensitivity of elemental analysis by charged-particle-induced x-ray fluorescence is examined by measuring characteristic x-ray cross sections for K_α, K_β, L_α, L_β, L_γ, and M transitions for many elements and bremsstrahlung backgrounds from thin mylar, kapton, and teflon films between 0.7 and 8 mg/cm^2 thickness. Sensitivities are given as a function of target atomic number, backing thickness, incident beam charge, energy and flux, and detector configuration. An evaluation of the strengths and weaknesses of charged-particle-induced x-ray emission for elemental analysis is included. (4 figures, 1 table) (auth)

35772 NEUTRON CAPTURE GAMMA RAYS FROM MIXTURES AND GEOLOGICAL SAMPLES. **Elkady, A. A. (Atomic Energy Establishtment, Cairo); Duffey, D.; Wiggins, P. F. Nucl. Instrum. Methods; 100: No. 3, 461-5(1972).**

Prompt gamma rays from thermal-neutron capture were used as a nondestructive technique for elemental analysis. A beam of thermal neutrons of about 10^6 neutrons/cm^2-s from a pool-type nuclear reactor was used to irradiate samples of mixtures of alumina, iron oxide, silica, calcium carbonate, gold, and a gold ore. The gamma rays were measured by a Ge(Li) detector connected to a 1024-channel pulse height analyzer. The components could be easily identified, and the spectroscopic data were in accord with the concentrations present. (4 figures) (auth)

35773 DETERMINATION OF COPPER AND MANGANESE IN MEAT BY NEUTRON ACTIVATION. **Fomin, A. A.; Mel'nik, A. D. (Inst. of Medical Radiology, Obninsk, USSR). Gig. Sanit.; No. 12, 68-9(Dec 1971). (In Russian).**

A procedure for neutron activation analysis of meat was developed, consisting of drying and calcining a one-gram sample of meat, exposing a weighed portion of the ash to thermal neutrons (2×10^{12} n · cm^2/sec) for 20 min. The heavy metals, including Cu and Mn, were separated from the alkali and alkaline earth metals by precipitating as sulfides at a pH of 9. The activity of the washed residue was measured and a formula was used to estimate quantitatively the Cu in the sample. The Mn was determined qualitatively. (K.S.W.)

35774 COMPLETE FACILITY FOR NEUTRON ACTIVATION ANALYSIS. **Nagorny, K. (Univ., Hamburg); Adami, H. J. Kerntechnik; 14: No. 4, 173-7(Apr 1972). (In German and English).**

A complete installation for neutron activation analysis is described, which can be used for purposes of research and instruction as well as for routine analysis in industry. Special attention is paid to the rabbit system and its control, to the irradiation chamber and to the gamma spectrometer. The difficulties that came up during the construction of this installation are described. (auth)

35775 RADIOCHEMICAL SEPARATION SCHEME FOR THE QUANTITATIVE DETERMINATION OF 45 ELEMENTS AND OF THE RARE EARTHS IN BIOLOGICAL SPECIMENS BY MEANS OF NEUTRON ACTIVATION. **Schuhmacher, J.; Maier-Borst, W. (Deutsches Krebsforschungzentrum, Heidelberg). Kerntechnik; 14: No. 4, 165-72(Apr 1972). (In German and English).**

The radiochemical separation scheme described makes it possible to carry out, with only one neutron irradiation of the specimen, a qualitative identification and quantitative determination of 45 elements and of the rare earths simultaneously and side by side. The following elements can be determined: Os, Cl, Br, I, Ru, As, Sb, Sn, Se, Hg, Re, Ge, Ba, Ag, Au, Pd, Pt, Te, W, Mo, Hf, Zr, U, Th, Fe, Ta, P, La, Y, Sc, rare earths, Cu, Cd, Co, Ni, Zn, In, Ga, Cr, Mn, Sr, K, Rb, Cs, Na, Ir. The separation scheme was used for the analysis of a biological specimen. The individual separation steps consist of distillations, ion exchange, isotope exchange, displacement reactions and organic and inorganic precipitations. The subdivision into groups follows as closely as possible the requirements of gamma spectroscopy. (auth)

35776 NONDESTRUCTIVE URANIUM ASSAY BY DELAYED GAMMA RAY ANALYSIS FOLLOWING ^{252}Cf NEUTRON INTERROGATION. **Atkinson, Gardner Davis Jr. Austin, Tex.; Univ. of Texas (1971). 196p. University Microfilms Order No. 72-15,700.**

Thesis.

A technique for nondestructive assay of uranium and other fissionable materials was investigated. In the proposed technique, spontaneous fission neutrons emitted by a californium-252 neutron source were used to induce fission in fissionable materials. Fissionable nuclide identification is then accomplished by analysis of the unique high-energy (above 511 keV) gamma signatures of the short-lived fission products. Cyclic activation is used to enhance the accumulation of information from these short-lived nuclides. The fission phenomena that form the bases for the proposed technique are described, as are the advantages of the technique, following a review of the major techniques presently used in nondestructive assay of fissionable materials. The feasibility of the technique was experimentally tested. Uranium standards with ^{235}U enrichments ranging from 23 ppM to 93% were assayed passively prior to being interrogated with thermalized neutrons from a 1-mg californium-252 neutron source, during which cyclic activation sequences were used with total analysis times ranging from 80 sec to 22 min. The fission product gamma spectra of the standards were obtained with a lithium-drifted germanium detector over the energy range from 0 to 4300 keV. The possible spectral contributors to each significant gamma peak above 511 keV were determined, and it was verified that as resolved by a high-resolution detector, the gamma peaks present were unique to fission products. Ten significant peaks were used to describe signatures for ^{235}U, and in simulated analyses, the technique was shown to yield standard deviations of 12, 9.5, and 3.5% for total analysis times of 80, 240, and 1320 sec, respectively. (Diss. Abstr. Int., B)

35777 DETERMINATION OF THE LOSSES OF GOLD, PLATINUM, RUTHENIUM, AND IRIDIUM DURING THE CUPELLATION PROCESS. **Georgiev, G. T.; Apostolov, D. (Sofia Univ. Inst. of Physics, Sofia). Zh. Anal. Khim.; 27: No. 3, 506-11(Mar 1972). (In Russian).**

The losses of Au, Pt, Ru, and Ir depending on the degree of the removal of Pb during the cupellation process were determined by means of nondestructive neutron activation analysis. The concentration in a silver regulus can not be used for Ru and Ir. The losses of Au, Pt, Ru, and Ir do not exceed 8% for microgram amounts of these elements when the cupellation process is carried out up to obtaining Pb reguluses of 0.1 g containing 0.02 g Ag. (auth)

35778 DIFFERENTIAL DETERMINATION OF BORON AND LITHIUM BY THE NEUTRON-RESONANCE METHOD. **Vakhtin, B. S.; Filippov, E. M. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Zh. Anal. Khim.; 27: No. 3, 595-7(Mar 1972). (In Russian).**

Boron and lithium can be determined differentially when silver foil is used as a detector for neutrons. The sensitivity level is 0.3 to 0.4%, the relative measurement error is about 6%. The duration of an analysis is about 10 min. (auth)

35779 SIMPLE MULTI-SAMPLE ROTATION DEVICE FOR ACTIVATION ANALYSES BY A NEUTRON GENERATOR. **Geisler, M. (Zentralinstitut fuer Isotopen- und Strahlentechnik, Leipzig). Isotopenpraxis; 7: No. 8, 321-5(Aug 1971). (In German).**

A device is described that provides a rotational symmetric activation of up to 7 samples under identical conditions. The samples rotate around two parallel axes. Test measurements by activation of samples containing Cu or N are reported. (auth)

35780 ACTIVATION ANALYSIS OF RARE EARTHS IN ROCK STANDARDS AND IN LUNAR SAMPLES. Kraehenbuehl, U.; Rolli, H. P.; von Gunten, H. R. (Univ., Bern). Helv. Chim. Acta; 55: No. 2, 697-701(1972). (In German).

The content of rare earth elements was determined in USGS-standard rocks BCR-1 and G-2, and in lunar fines samples from Apollo-12 using activation analysis techniques. (auth)

35781 DEUTERON ACTIVATION ANALYSIS OF CARBON IN SILICON. Martin, J.; Haas, E. (Siemens AG, Erlangen, Ger.). Z. Anal. Chem.; 259: No. 2, 97-100(1972). (In German).

Determination of carbon in silicon by deuteron activation methods yielded excessively high percentages because the carbon injected into the specimens from the accelerator was also detected in the analysis. If the injected carbon percentage is removed by etching of defined surface layers of the activated specimens, a useful analysis method is obtained by which the presence of amounts as small as 0.2 ppM (w) at a variance of individual values of 10% can be determined without chemical separation of the ^{13}N. The analyses of semiconductor silicon performed by the method described proved that the content of carbon in polycrystalline silicon is equal to or less than 0.5 ppM (w), that of zone-refined silicon less than 0.2 ppM (w). The carbon concentration in crucible-refined silicon is of the order of 10 ppM (w), which is due to the entrainment of carbon into the silicon melt in the crucible. (auth)

35782 NEUTRON RADIOACTIVATION ANALYSIS IN VIVO OF SOME ELEMENTS CONTAINED IN THE RAT'S ORGANISM. Chasteland, M.; Comar, D. (CEA, Orsay, France). Int. J. Appl. Radiat. Isotop.; 23: No. 5, 209-18(May 1972). (In French).

The possibility was examined of combined analysis for calcium, phosphorus, nitrogen, and chlorine in the adult rat by neutron activation in vivo. In the studies described the activating particles were produced by a 400-kV, 2-mA SAMES accelerator giving a neutron output at 14 MeV of the order of 1×10^{11} n.cm^{-2}s^{-1} in 4π. The animals were placed in a rotating device surrounded by paraffin wax and irradiated for 10 min. The mean flux of 14-MeV neutrons measured at the surface of the cylindrical box containing the rat was 7.5×10^{6} n.cm^{-2}s^{-1} and the thermal flux 1.1×10^{7} n.cm^{-2} s^{-1}. The radioactivity of the elements ^{49}Ca, ^{13}N, ^{38}Cl, and ^{28}Al was measured with a NaI(Tl) crystal. Various sources of error under the chosen operating conditions are examined. The results are compared with data reported in the literature. (auth)

35783 DETERMINATION OF IODINE BY NEUTRON ACTIVATION ANALYSIS IN CdS, CdTe, GaSe, AND GaS DOPED CRYSTALS. Orvini, E. (Univ., Pavia, Italy). Radiochem. Radioanal. Lett.; 10: No. 3, 145-9(30 May 1972).

The iodine content of CdS, CdTe, GaSe, and GaS semiconductor crystals was determined by neutron activation analysis, utilizing intermediate neutrons to eliminate the matrix self-shielding effect. (auth)

35784 DETERMINATION OF MOLYBDENUM IN STEELS BY NEUTRON ACTIVATION AND SUBSTOICHIOMETRIC EXTRACTION WITH CRYSTAL VIOLET. Nadkarni, R. A.; Haldar, B. C. (Inst. of Science, Bombay). Radiochem. Radioanal. Lett.; 10: No. 3, 183-9(30 May 1972).

A method was developed for determination of molybdenum, based on the thermal neutron activation and subsequent extraction with substoichiometric amounts of Crystal Violet in chloroform from 4 to 6N HCl solutions. The method is selective; a large number of elements, including W(VI), do not interfere. Four samples and one standard can be analyzed within an hour after irradiation. The method was applied to the determination of molybdenum in NBS steels. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 35968, 36068, and 38014.

35785 (ANL-7891) CHARACTERIZATION OF THE VANADIUM-WIRE EQUILIBRATION METHOD FOR MEASUREMENT OF OXYGEN ACTIVITY IN LIQUID SODIUM. Smith, Dale L.; Lee, Richard H. (Argonne National Lab., Ill.). Jan 1972. Contract W-31-109-eng-38. 16p. Dep. NTIS.

A standardization and characterization program has been conducted to qualify further the vanadium-wire equilibration method as a standard for analysis of oxygen in sodium for the LMFBR Sodium Technology Program. Additional data were obtained to enhance the reliability of the experimentally determined equilibrium distribution coefficient for oxygen between vanadium and sodium at 750°C. Equilibrium-distribution values in the range of 0.003 to 16 ppM oxygen in sodium are tabulated in terms of weight-percent oxygen in vanadium. Oxygen analyses determined by the equilibration method are compared with electrochemical cell measurements. Consistent results were obtained with the thoria-15 wt % yttria electrolyte cells using both Cu-Cu_2O and Na-Na_2O reference electrodes. Experimental evidence included indicates that the presence of carbon, nitrogen, and hydrogen in vanadium of nominal purity and in sodium at levels expected under LMFBR or experimental loop conditions will not significantly affect the measurement of the oxygen activity in sodium by the vanadium-wire equilibration method. (auth)

35786 (CSIRO-Trans-10756) KINETIC METHODS OF QUANTITATIVE ANALYSIS. III. DETERMINATION OF SMALL AMOUNTS OF MOLYBDENUM. Yatsimirskii, K. B.; Afanas'eva, L. P. Translated by M. Prazak (Commonwealth Scientific and Industrial Research Organization), from Zh. Anal. Khim.; 11: 319-22(1956). 4p. Dep. NTIS (U. S. Sales Only).

The method is based on the use of molybdate for the catalysis of the oxidation reaction of iodide with H_2O_2. The method was tried in the concentration range from 1.8×10^{-7}M to 9.1×10^{-7}M. The effect of vanadate and tungstate is to increase reaction rate and mercury, cadmium, and phosphate decrease rate. Iodine precipitation is not observed in the presence of silicate and arsenate. Co, Ni, Cu, Ca, Mg, Mn, Zn, and Cr^{3+} do not affect reaction rate. (Australia)

35787 (NLCO-1091) SEMIAUTOMATIC DETERMINATION OF TRACES OF URANIUM. Prall, J. R. (National Lead Co. of Ohio, Cincinnati). 27 Apr 1972. Contract AT(30-1)-1156. 22p. Dep. NTIS.

An automatic colorimetric method for the determination of low-level uranium was developed for process control work. The bromine derivative of the heterocyclic dye PADAP, 2-[(5-bromo-2-pyridyl)azo]-5-(diethylamino)phenol, was applied to the procedure. A basic AutoAnalyzer system consisting of an industrial sampler, a proportioning pump, and a photocell colorimeter equipped with 580 nm filters was used. Low level interferences were separated by solvent extraction with TOPO. A variation of the solvent extraction method is given for treatment of samples containing high-level Th and Zr. Results are compared with those obtained by fluorometry. (J.G.B.)

35788 (ORO-4045-6) GASEOUS ION CHEMISTRY: ANALYTICAL APPLICATIONS. Progress Report II, May 1, 1971-January 31, 1972. Torrey, Rubye P. (Tennessee State Univ., Nashville). 1972. 6p. Dep. NTIS.

Progress is reported in studies on the operating efficiency of a high-pressure ion source used with a mass spectrometer. In an attempt to identify reactant species along the electron track, ionization efficiency and onset potentials of Ar(I) and Ar(II) were measured. Results suggest that Ar(I) is a precursor for Ar(II). Pressure and electron energy appear to be the most significant variables. (J.G.B.)

35789 (RCN-157) CHEMICAL ANALYSIS OF HIGH BURN-UP PuO_2 FUEL. II. RESULTS ON DRAGON-FUEL. Joon, K.; den Boef, R.; Haaland, J.; Stijfhoorn, D. E.; de Wit, R. (Reactor Centrum Nederland, Petten). Oct 1970. 25p. Dep. NTIS (U. S. Sales Only).

The results of a chemical analysis with respect to isotopic composition and total content of the elements Zr, Mo, Ru, Cs, Nd, Pm, Sm, Eu, and Pu in a batch of irradiated pyrocarbon-silicon carbide-coated PuO_2 fuel particles are reported and discussed. (auth)

35790 MASS-SPECTROMETRIC ANALYSIS OF THE ISOTOPIC COMPOSITION OF BORON IN ITS DIFFICULTY VOLATILE COMPOUNDS BY MEANS OF FLUORINATION OF THEM. Lyubimov, V. N.; Semyannikov, P. P.; Grankin, V. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Isotopenpraxis; 8: No. 1, 26-8(Jan 1972). (In Russian).

A technique of isotope analysis of boron in its low-volatility compounds was developed by fluorination of them with lead fluoride immediately in the mass spectrometer ion source. The isotope composition of elemental boron as amorphous powder and in the boron steel as well as of boron in its compounds B_4C, BN, B_2O_3, $Na_2B_4O_7$, $Nd(BO_2)_3$, $NdBO_3$ is determined with the help of this technique. The method of rapid and reliable elimination of memory effect is recommended. (auth)

35791 SPECTROPHOTOMETRIC STUDY OF THE SCANDIUM-DIANTIPYRYLMETHANE-SFADNS MIXED COMPLEX. Ganago, L. I.; Alinovskaya, L. A. (Inst. of the Physics of Solids and Semiconductors, Minsk). Zh. Anal. Khim.; 27: No. 2, 261-5 (Feb 1972). (In Russian).

The interaction of scandium with diantipyrylmethane and the sodium salt of 2-(4-sulfophenylazo)-1,8-dihydroxynaphthalene-3,6-disulfonic acid was studied. The composition of the ternary complex 1 : 2 : 2 was found by the isomolar series method and the equilibrium shift method. The apparent molar extinction coefficient was calculated. The number of hydrogen ions replaced from a reagent molecule by a scandium ion was found graphically. The complex structure is suggested. A method of scandium determination as the ternary complex was developed. (auth)

35792 ANALYTICAL USE OF THE EXTRACTION OF THE RARE EARTH IONIC ASSOCIATES WITH 2-PHENYLQUINOLINE-4-CARBOXYLIC ACID AND RHODAMINE B. Poluektov, N. S.; Bel'tyukova, S. V.; Meshkova, S. B. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 27: No. 2, 266-9 (Feb 1972). (In Russian).

The rare earth ions form complex compounds with 2-phenylquinoline-4-carboxylic acid and Rhodamine B, which can be extracted with benzene. The ratio of the components is Me : HPQC : Rhod = 1 : 4 : 1. A photometric method is suggested for determining lanthanum in the presence of yttrium based on masking yttrium with Tiron. (auth)

35793 ADDITION METHOD IN THE DETERMINATION OF LANTHANIDES BY THE LUMINESCENCE OF CRYSTAL PHOSPHORS. Poluektov, N. S.; Efryushina, N. P.; Smirdova, N. I.; Gava, S. A. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 27: No. 2, 282-8(Feb 1972). (In Russian).

A method is suggested for finding the range of permissible lanthanide concentrations during its determination by means of the addition method by luminescence of crystal phosphors. The method is based on using the regularities of concentration quenching. The method was used for examining the conditions of determining certain lanthanides in crystal phosphors based on lanthanum oxychloride and yttrium orthovanadate. (auth)

35794 STUDY OF THE CHEMISTRY OF THE REACTIONS BETWEEN THE IONS OF MULTIVALENT ELEMENTS AND ORGANIC REAGENTS. COMMUNICATION 26. THE INTERACTION OF MOLYBDENUM(VI) WITH TRIHYDROXYFLUORONES AND ANTIPYRINE. Nazarenko, V. A.; Shelikhina, E. I.; Antonovich, V. P. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 27: No. 2, 307-14(Feb 1972). (In Russian).

A study was carried out of complex compounds of molybdenum with trihydroxyfluorones and antipyrine that are extracted as solvates with chloroform ionic associates in the presence of strong acid anions. The ratio molybdenum : propyltrihydroxyfluorone : antipyrine : acid anion : $CHCl_3$ in the extracted complex is 1 : 1 : 2 : 1 : 6. The instability constant of the extracted four-component complex ($pK_{inst} = 19.8 \pm 0.2$) was calculated by various methods taking into account the ionization constants of propyltrihydroxyfluorone and antipyrine and the hydrolysis constants of the MoO_2^{2+} ion. The expediency of using the four-component complexes for the extraction-photometric determination of microgram amounts of molybdenum is shown. (auth)

35795 DIFFERENTIAL COULOMETRIC TITRATION OF THE MIXTURE OF IRON(II), MANGANESE(II), VANADIUM(VI), AND CERIUM(III) IONS WITH ELECTROGENERATED BICHROMATE IN PHOSPHORIC ACID. Kostromin, A. I.; Akhmetov, A. A.; Burygina, L. N. (Kazan State Univ.). Zh. Anal. Khim.; 27: No. 2, 315-19(Feb 1972). (In Russian).

Conditions for separate coulometric titration of the mixture of Fe(II), Mn(II), VO^{2+}, and Ce(III) ions with electrogenerated bichromate have been studied. The method was used for the determination of manganese and vanadium in steel. (auth)

35796 ORGANIC REAGENTS IN ANALYTICAL CHEMISTRY OF SELENIUM AND TELLURIUM. COMMUNICATION 3. INVESTIGATION OF THE REACTION OF TELLURIUM IONS WITH BUTYL RHODAMINE B. Murashova, V. I.; Skripchuk, V. G. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Anal. Khim.; 27: No. 2, 340-5(Feb 1972). (In Russian).

Optimum conditions for the reaction of tellurium(VI) bromide complex with butyl Rhodamine B are 5.0 to 5.2M H_2SO_4, 0.12M NaBr, 2.8×10^{-4}M reagent solution. The molar ratio of Te : R : Br in the compound is 1 : 1 : 6. The solid ionic associate of tellurium with butyl Rhodamine B was isolated. Chemical analysis of the associate confirmed the results of photometric investigation. (auth)

35797 REACTIONS OF 1-HYDROXYXANTHONE WITH METALLIC IONS. Murata, Akira; Nakamura, Motoshi (Shizuoka Univ., Hamamatsu, Japan). Jap. Anal.; 21: No. 4, 487-91(Apr 1972). (In Japanese).

The reaction of 1-hydroxyxanthone (2,3-benzo derivative of 5-hydroxychromone), which is a useful reagent for the spectrophotometric or fluorometric determination of some cations, with about forty metallic ions was studied. The reagent was prepared by fusing resorcinol with salicylic acid in the presence of zinc chloride. The investigations were carried out on the solutions ranging in pH from 1 to 12, which contained 1×10^{-6} mol of metallic ion, 1.5×10^{-5} mol of reagent, and 50 vol % of methanol in 25 ml. When precipitation or coloration was observed, extraction with the organic solvents was attempted. Thirteen ions react with this reagent. The following ions give the precipitates that are insoluble in the organic solvents: magnesium, yellow, pH > 10; titanium, pale yellow-green, pH > 5; zirconium, yellow, pH > 4; cerium(IV), yellow, pH > 8; thorium, yellow, pH > 7. Aluminum reacts to form a soluble yellow-brown complex in the range of pH 2 to 10 with a maximum absorbance at pH about 5 and uranium to form a yellow-brown complex in the range of pH 7 to 11 with a maximum absorbance at pH about 9. These can not be extracted. Nickel and cobalt react to form yellow precipitates at pH > 7. These can be extracted, but they are very unstable. Palladium forms a yellow precipitate at pH > 2. It can be extracted, but the organic phase becomes slightly turbid. Iron(III) gives dull green in the range of pH 1 ~ 4 with a maximum absorbance at pH about 2.5 and a red-brown precipitate at pH > 8. The latter complex can be extracted with the organic solvents, but it is unstable. Beryllium and copper react to form yellow precipitates at pH > 5 which can be extracted and they are stable. The beryllium complex shows a strong fluorescence in ultraviolet radiation similarly to its 5-hydroxychromone complex. The number of reacting cations is less than that which reacts with 5-hydroxychromone and the complexes extracted are very unstable except those of beryllium and copper. Beryllium and copper can be determined spectrophotometrically. An analytical procedure is as follows: To a sample solution containing up to 7 μg of beryllium or 40 μg of copper, are added 10 ml of 3×10^{-3}M methanol solution of the reagent, 2.5 ml of methanol, 5 ml of buffer solution (boric acid-sodium hydroxide, 0.25M in boric acid, pH 8 for beryllium, pH 11 for copper), and it is made up to 25 ml with water. After about one hour, the solution is shaken for thirty seconds with 10 ml of benzene. The organic phase is separated and dried over sodium sulfate. Its absorbance is measured at 430 mμ for beryllium or 440 mμ for copper. Both analytical curves are linear. (auth)

35798 PROCEEDINGS OF THE THIRD ANNUAL SYMPOSIUM ON HIGH-RESOLUTION ANALYSES AND ADVANCED CONCEPTS FOR THE CLINICAL LABORATORY, OAK RIDGE, TENNESSEE, MARCH 11–12, 1971. Clin. Chem.; 17: No. 8, 685-821(Aug 1971). (CONF-710339).

Twenty papers were presented in three sessions on GeMSAEC fast analyzers, analytical concepts and systems, and applications, and experimental results. Separate abstracts were prepared for two of the papers. (R.W.R.)

For abstracts of individual papers see: 36292 and 36428.

35799 Zr(IV) THIOCYANATE COMPLEX: ITS USE AS A FREE Zr(IV) OR THIOCYANATE INDICATOR. Tribalat, Suzanne; Schriver, Louise (Univ., Paris). Compt. Rend., Ser. C; 274: No. 9, 849-52(28 Feb 1972). (In French).

The formation constant of a Zr(IV) SCN^- complex was determined by spectrophotometry (11.5 ± 1 for I = 3.5); the degree of concentration of this complex was used for determining free Zr or thiocyanate. Previous results on the dimerization of thiocyanate ions were confirmed. The acidity constant of thiocyanic acid was determined ($K_A = 7.5 \pm 1$ for I = 3.5) together with the formation constant of the Zr monochloride complex (0.3 ± 0.05 for I = 3.5); the trimerization of Zr(IV) was observed for various acidities. (France)

35800 CALIBRATION METHODS AND INSTRUMENTATION FOR OPTICAL ^{15}N DETERMINATIONS WITH ELECTRODELESS DISCHARGE TUBES. Ferraris, Marco M.; Proksch, Guenter (IAEA Lab., Seibersdorf, Austria). Anal. Chim. Acta; 59: No. 2, 177-85(Apr 1972).

For the electrodeless excitation of nitrogen in discharge tubes a commercially available microwave power generator as well as two antennas and two resonant cavities were compared with respect to their stability, the fitting of the discharge tube and the cooling possibilities. Different methods of evaluation of the spectra to determine the nitrogen-14/15 ratio for the whole range of nitrogen-15 concentration 0.365% (natural) to 97% were studied empirically and 4 methods were recommended for different ranges of concentration. (auth)

35801 DIFFERENTIAL SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM IN FERROMOLYBDENUM. Ashy, M. A.; Headridge, J. B. (Univ. of Sheffield, Eng.). Anal. Chim. Acta; 59: No. 2, 217-23(Apr 1972).

A differential spectrophotometric method is described for the determination of molybdenum in ferromolybdenums based on the reddish-orange molybdenum (V) species formed in sulfuric acid solution on reduction with hydrazine sulfate. Interference from iron is eliminated by reduction of the iron(III) to iron(II) with sulfur dioxide. Of the elements that could be found in minor or trace amounts in ferromolybdenum, only copper and phosphorus show slight interfering effects. When account was taken of the slight interference from copper in the determination of molybdenum in sixteen ferromolybdenums, results of good accuracy and precision were obtained. (auth)

35802 INTERMEDIATE STORAGE TECHNIQUE IN ORGANIC MICROANALYSIS. PART I. DETERMINATION OF HALOGENS. Trutnovsky, H.; Sakla, Alfy B. (Univ., Graz). Anal. Chim. Acta; 59: No. 2, 285-91(Apr 1972).

A method is described for the microdetermination of halogens in organic compounds. The samples are burned in a rapid flow of oxygen (50 ml $\min^{-1}$) at 950° and the halogens are stored in a heated silver layer at 480°. After the combustion the silver halides are reduced with hydrogen (30 ml $\min^{-1}$) and the hydrogen halides are easily absorbed in a small quantity of water. As the solution contains no foreign ions, any procedure for completing the determination can be used. (auth)

35803 ISOLATION OF ZIRCONIUM ISOTOPES FROM FISSION PRODUCTS FOR MASS SPECTROMETRIC DETERMINATION. Krtil, J.; Moravec, A.; Mencl, J. (Inst. of Nuclear Research, Rez, Czech.). Radiochem. Radioanal. Lett.; 10: No. 2, 83-90(14 May 1972).

An isolation method of weighable amounts of zirconium, based on extraction with bis(2-ethylhexyl) phosphate (DEHPA) in toluene from a mixture of nitric and hydrofluoric acid, was elaborated. Factors influencing the extraction and reextraction of zirconium were studied in detail and the procedure was verified on the isolation of zirconium from irradiated uranium. (auth)

35804 POLAROGRAPHIC DETERMINATION OF EUROPIUM IN AMERICIUM IN AN ACETONITRILE MEDIUM. Myasoedov, B. F.; Kulyako, Yu. M.; Sklyarenko, I. S. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 10: No. 2, 123-9(14 May 1972).

The polarographic determination of europium in americium is described in acetonitrile as solvent. The sensitivity with respect to Eu is 5×10^{-5}M. (auth)

35805 SIMULTANEOUS DETERMINATION OF TIN AND HALOGEN IN TIN ORGANIC COMPOUNDS. Obtemperanskaya, S. I.; Fam Tki Hoi; Karandi, I. V. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 1, 119-21(Jan-Feb 1972). (In Russian).

A method was developed for the simultaneous determination of tin and halogen in tin organic compounds. The method is based on oxidation of a substance by oxygen in the presence of sulfuric acid. Tin and the halogen are determined gravimetrically and by titration, respectively. (auth)

35806 INVESTIGATION OF THE CHROMATOGRAPHY OF COMPLEX COMPOUNDS OF METALS IN NON-AQUEOUS SOLUTIONS. THIN-LAYER CHROMATOGRAPHIC SEPARATION OF METALLIC 8-QUINOLINOLATES FROM EXCESS 8-QUINOLINOL. Busev, A. I.; Kharlamov, I. P.; Garibyan, G. H. (Moscow State Univ.). Anal. Lett.; 5: No. 4, 243-8(1972).

It was established that is is possible to separate 8-quinolinol from its complex with various metals by a thin-layer chromatographic technique. This results in increased sensitivity by permitting the use of a more intensive absorbance maximum in the ultraviolet region of the spectrum. The determination of Al in steels of Mn, Ni—Cr—Mo—Nb—W, Ni—Cr—Ti—V—Mo, and Cr—Ni—Cu was studied. (auth)

35807 X-RAY FLUORESCENCE DETERMINATION OF ARSENIC, ANTIMONY, NICKEL, RUBIDIUM, SCANDIUM, VANADIUM, AND ZINC IN ROCK STANDARDS AND OTHER ROCK SAMPLES. Fabbi, Brent P.; Espos, Laureano F. (Geological Survey, Menlo Park, Calif.). U. S., Geol. Surv., Prof. Pap.; No. 800-B, 147-50(1972).

Arsenic, antimony, nickel, rubidium, scandium, vanadium, and zinc were determined in 18 rock standards and eight rock samples, making corrections for matrix and interelement effects where necessary. Detection limits for these elements are 3 to 70 ppM. X-ray fluorescence values obtained are in good agreement with the preferred or chemical values. (auth)

35808 CHEMICAL ANALYSIS OF RUTILE: DIRECT SPECTROPHOTOMETRIC DETERMINATION OF TITANIUM, TOTAL IRON, NIOBIUM, PHOSPHORUS, AND VANADIUM. Meyrowitz, Robert (Geological Survey, Washington, D. C.). U. S., Geol. Surv., Prof. Pap.; No. 800-B, 157-64(1972).

Titanium, total iron, niobium, phosphorus, and vanadium are directly determined in rutile using hydrogen peroxide, 1,10-phenanthroline, 4-(2-pyridylazo)-resorcinol[PAR], heteropoly blue, and phosphotungstovanadate procedures, respectively. One part of each sample is decomposed by potassium pyrosulfate fusion in a transparent quartz crucible, and a sulfuric acid solution of the melt is used for the determination of titanium, iron, niobium, and phosphorus. A second part is decomposed by sodium carbonate fusion in a platinum crucible, and a sulfuric acid solution of the melt is used for the determination of vanadium. The elements commonly present in rutile do not interfere in the determination of titanium, iron, and phosphorus. Titanium and iron interference in the determination of niobium is eliminated by adding the titanium and iron contents of the sample to the standard niobium solutions used for the standard niobium curve. Similarly, iron interference in the determination of vanadium is overcome by adding the iron content of the sample to the standard vanadium solutions used for the standard vanadium curve. (auth)

35809 VERY LOW LEVEL ^{210}Po DETERMINATION BY ELECTROCHEMICAL DISPLACEMENT METHOD. Abe, Michiko; Abe, Siro (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo); 21: No. 4, 215-18(Apr 1972).

Recovery of very low level ^{210}Po (10^{-12} to 10^{-14} Ci) from nitric acid solutions was investigated by a electrochemical displacement method, which is the simplest method and which yields high recovery for very low level ^{210}Po. Under experimental conditions used here, it was found that recovery even for very low level ^{210}Po of 10^{-12} to 10^{-14} Ci was more than 90%. However, no impurities were present in these solutions. (auth)

35810 REACTION OF YTTERBIUM WITH THE BOROSULFOALIZARIN COMPLEX AND ETHYLENEDIAMINE. Serdyuk, L. S.; Avramenko, L. I. (Chernovitsy State Univ.). Zh. Anal. Khim.; 27: No. 3, 464-7(Mar 1972). (In Russian).

The ternary sulfoalizarinethylenediamine complex of ytterbium is formed in the system ytterbium—the borosulfoalizarin complex—ethylenediamine with the absorption maximum at 510 nm and the molar extinction coefficient for this wave length of 41,000 ± 300. The optimum pH value for the complex formation is within 9.5 and 10.0. It is shown by the methods of molar ratios and equilibrium shift that ytterbium, Alizarin S, and ethylenediamine are in the ternary complex at a ratio of 1 : 6 : 3. The composition of the complex can be expressed as $\mathrm{YbAlis_3 \cdot 3EnAlis}$. Ytterbium forms sulfoalizarinate $\mathrm{YbAlis_3}$ with alizarin S in the absence of ethylenediamine at the same pH value. The elements of the cerium subgroup, neodymium, praseodymium, and lanthanum do not form ternary sulfoalizarinethylenediamine complexes. A method was developed for extraction-photometric determination of ytterbium in the presence of neodymium, praseodymium, and lanthanum. (auth)

35811 X-RAY FLUORESCENT DETERMINATION OF MICRO AMOUNTS OF NEPTUNIUM. Novikov, Yu. P.; Kakhana, M. M.; Il'in, N. P.; Margorina, M. N. Zh. Anal. Khim.; 27: No. 3, 479-82(Mar 1972). (In Russian).

An x-ray fluorescent method for determination of μg amounts of Np is suggested. The method allows determination of Np after different ways of sample preparation of pure solutions and solutions containing Pu. The sensitivity of the method is 0.2 to 0.3 μg Np with a relative standard error of 5% when >1 μg Np is determined. The duration of an analysis is 30 to 40 min including sample preparation. (auth)

35812 DETERMINATION OF NIOBIUM, TITANIUM, AND IRON USING AN ALTERNATING CURRENT POLAROGRAPH. Kurbatov, D. I.; Il'kova, S. B. (Inst. of Chemistry, Sverdlovsk, USSR). Zh. Anal. Khim.; 27: No. 3, 483-6(Mar 1972). (In Russian).

The values of velocity constants of the electrochemical reduction process, calculated from active and reactive components of the cell current, for Fe(III), Ti(IV), and Nb(V) in the presence of H_3PO_4 show that the process of Fe(III) and Ti(IV) reduction proceeds almost as a reversible one and for Nb(V) almost as an irreversible one. It makes possible increasing the sensitivity of determining Fe and Ti when alternating current polarographs are used. A possibility of determining Fe and Ti in metallic Nb, Ta, and their compounds as well as in alloys based on rare earths, iron, and aluminum without separation with the sensitivity of 0.001% has been shown. The probable relative error does not exceed 3% when the content of the elements determined is 1 to 4%. (auth)

35813 KINETICS AND MECHANISM OF THE CATHODE REDUCTION OF MOLYBDENUM ON A DROPPING MERCURY ELECTRODE IN PYROPHOSPHORIC ACID SOLUTIONS. Kurbatov, D. I. (Inst. of Chemistry, Sverdlovsk, USSR). Zh. Anal. Khim.; 27: No. 3, 487-91(Mar 1972). (In Russian).

The polarographic reduction of Mo(VI) in pyrophosphoric acid solutions has been studied. Mo(VI) is reduced in two steps: Mo(VI) + e → Mo(V) + e → Mo(IV). The reduction is irreversible. The kinetics of electrode reduction of Mo(V) have been investigated and a possibility of the use of pyrophosphoric acid solutions for polarographic determination of molybdenum was shown. (auth)

35814 DIFFERENTIAL COULOMETRIC TITRATION OF MANGANESE(VII), CERIUM(IV), AND VANADIUM(V) FOR THEIR DETERMINATION IN ALLOYS WITH GENERATED IONS OF IRON(II). Nikolaeva, E. R.; Lakeeva, T. N.; Agasyan, P. K. (Moscow State Univ.). Zh. Anal. Khim.; 27: No. 3, 497-501(Mar 1972). (In Russian).

The electrochemical behavior of Mn(VII), Ce(IV), and V(V) mixtures on a platinum electrode was compared for solutions of H_2SO_4 and $H_2SO_4 + H_3PO_4$. A possibility was shown for the differential coulometric titration of Mn(VII), Ce(IV), and V(V) with generated iron (H) in a solution of 2M H_2SO_4 using two polarized platinum electrodes ($\Delta E = 0.2-0.5$ v) for endpoint detection. The method was used for determination of 0.003 to 0.005% Ce and 0.025 to 0.34% V in alloys without their separation. (auth)

35815 METHOD OF MASS-SPECTROGRAPHIC ELEMENT ANALYSIS OF GEOLOGICAL SAMPLES, METEORITE MATTER, AND SAMPLES OF MOON SOIL. Chupakhin, M. S.; Polyakov, A. L. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 27: No. 3, 523-33(Mar 1972). (In Russian).

A method of analysis of nonconductive substances without introducing conductive additives by means of a mass spectrograph with a spark ionic source is suggested. The method is distinguished by a small consumption of a sample (1 to 1.5 mg), high sensitivity (up to 10^{-7} at. %), satisfactory reproducibility of results (8 to 12%). The analyses of moon soil were carried out for main and trace rock-forming elements. (auth)

35816 AMMONIA IN ORGANIC ANALYSIS. COMMUNICATION 2. DIFFERENTIAL DETERMINATION OF ORGANIC AND INORGANIC BOUND FLUORINE PRESENT TOGETHER. Volodina, M. A.; Pivovarova, A. A. (Moscow State Univ.). Zh. Anal. Khim.; 27: No. 3, 568-73(Mar 1972). (In Russian).

A method was suggested for determining total content of fluorine and organic and inorganic bound fluorine separately in a mixture of an individual organofluorine substance and a metal fluoride. The method is based on the pyrolysis of the mixture in a current of ammonia with an addition of ammonium sulfate. The end determination of fluoride ion is carried out by means of thoriometric titration. (auth)

35817 COMPLEX FORMATION OF SCANDIUM WITH ETHYLENEDIAMINETETRAACETIC ACID. Kornev, V. I.; Babina, I. M.; Vekshin, V. V. (Udmurt State Pedagogic Inst., Izhevsk, USSR). Zh. Anal. Khim.; 27: No. 3, 597-600(Mar 1972). (In Russian).

The complex formation of scandium with ethylenediaminetetraacetic acid in aqueous solutions at pH 2.5 to 3.5 was studied photoelectrocolorimetrically as a method for determination of scandium. Scandium forms with complexone a complex of 1 : 1. The instability constant of the complex of ScY^- was determined, $pK_H = 21.84$. (auth)

35818 NEW MEDIUM FOR CARRYING OUT ISOTOPE ANALYSIS OF WATER BY THE SPOT METHOD. Lyubimov, V. N.; Voloshkevich, E. D.; Karyakina, T. G. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Anal. Khim.; 27: No. 3, 604-7(Mar 1972). (In Russian).

The characteristics of the mixtures of benzene–hexafluorobenzene and O-fluorotoluene–octafluorotoluene as media for isotope analysis of water by the spot method were studied. These mixtures were compared with the known earlier mixture of xylene–chlorobenzene. The mixture of O-fluorotoluene–octafluorotoluene considerably surpasses other mixtures by the stability during some time and the sensitivity to a small change of D_2O concentration and it can be recommended for isotope analysis of water in the region of 0 to 100% D_2O. (auth)

35819 POTENTIOMETRIC DETERMINATION OF SOME HEAVY METALS WITH HALOGENATED OR METHYL DERIVATIVES OF 8-MERCAPTOQUINOLINE. Berzinya, V. K.; Yanson, E. Yu.; Osherova, E. A. Uch. Zap., Latv. Gos. Univ.; 117: 127-32(1970). (In Russian).

For the determination of Cu(II), Pb, Mo(VI), Zn, or Ag by titration with 5-bromo-8-mercapto- or 8-mercapto-4-methylquinoline, the potentiometric method is inferior in sensitivity to the amperometric method by a factor of 10; sometimes, however, the potentiometric method is more selective. For example, with a background electrolyte a 3N-H_2SO_4 and with 8-mercapto-4-methylquinoline as titrant, Ag and Pb can be determined in the presence of two- and fourfold amounts, respectively, of Cu(II). When the potentiometric method described is used, the sensitivity for the elements mentioned ranges from 30 to 90 μg, and there is a wide choice of masking agents for interfering cations. (Referativnyi Zh.)

35820 MORIN AS PRECIPITATING AGENT. DETERMINATION OF ZIRCONIUM. Bosch-Reig, F.; Burriel-Marti, F. (Univ., Madrid). Inform. Quim. Anal., Pura Apl. Ind.; 25: No. 3, 86-90(1971). (In Spanish).

Zr(IV) is precipitated with morin in H_2SO_4 medium and the precipitate washed, calcined at 900°, and weighed as ZrO_2. Optimum conditions were found to be a concentration of H_2SO_4 of 2M, a ratio of morin to ZrO_2 of >11 to 7, and washing of the precipitate with 0.1M H_2SO_4 containing 20% ethanol. The interference caused by Ti(IV) when the ratio of TiO_2 to ZrO_2 is >1 : 2 can be avoided by a second precipitation after redissolving the initial precipitate in dilute aqueous NH_3. (Anal. Abstr.)

35821 PHOTOMETRIC DETERMINATION OF BORON, MOLYBDENUM, MANGANESE, COPPER, AND ZINC IN THE WATER OF FISH-FARMING PONDS. Ushakova, V. F. Gidrokhim. Mater.; 54: 110-18(1970). (In Russian).

The method described is applicable to water containing large amounts of organic matter. The sample (200 ml for Mn, Cu, and Zn, 500 ml for B, or 1 liter for Mo) is evaporated to dryness on a sand bath, the residue heated at 450 to 500°C and determined with quinalizarin, Mo with SCN^-, Mn with $S_2O_8^{2-}$, Cu by the reaction with Ni diethyl phosphorodithioate, and Zn with dithizone. The sensitivities (μg per liter) are B 0.01, Mo 0.02, Mn 1.0, and Cu and Zn 0.2. (Referativnyi Zh.)

35822 NEW COLOR REACTION OF NEPTUNIUM WITH ARSENAZO M. Novikov, Yu. P.; Myasoedov, B. F.; Margorina, M. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 10: No. 1, 11-17(14 Apr 1972).

The new reaction of neptunium(IV) with Arsenazo M was studied spectrophotometrically as a function of the concentration and nature of the acid and of the reagent excess. The molar extinction coefficients are $\bar{\epsilon}_{664} = 118000 \pm 2000$ (7N HCl) and 94800 ± 1600 (0.5N HCl), the contrast of reaction $\Delta\lambda = 120$ nm. A method is suggested for the determination of neptunium. (auth)

35823 MORDANT BLUE 31 ASA NEW FLUOROMETRIC REAGENT FOR ALUMINUM, GALLIUM, AND SCANDIUM. Hiraki, Keizo (Kinki Univ., Osaka). Bull. Chem. Soc. Jap.; 45: No. 3, 789-93(Mar 1972).

A sensitive fluorometric determination of aluminum, gallium, and scandium with Mordant Blue 31 was developed. The reagent reacts with aluminum, gallium, scandium, yttrium, lanthanum, lutetium, indium, and magnesium in acidic or basic medium to form complexes with reddish yellow fluorescence. The complexes of aluminum (pH: 5 to 7), gallium (pH: 4), and scandium (pH: 6) exhibit strong fluorescence with an emission maximum at 590, 600, and 610 nm, respectively. The effects of time, pH, and the concentration of the reagent were investigated. In acidic medium, aluminum, gallium, and scandium were found to form 1 : 1 complex with Mordant Blue 31. Under the optimum conditions, 0.1 to 3 μg of aluminum, 1 to 12 μg of gallium, and scandium in 25 ml sample solution could be determined. Although the fluorescence intensity of aluminum and gallium complexes was a little lower than that of the lumogallion complexes, Mordant Blue 31 was also applicable as a fluorometric reagent for aluminum and gallium. Since the scandium–Mordant Blue 31 complex exhibits the strongest fluorescence of all the scandium–azo dye complexes, the reagent was used as a fluorometric reagent for scandium. (auth)

35824 ANALYSIS OF H_2O–D_2O MIXTURES BY THE SF-4 SPECTROPHOTOMETER. Lemeshko, G. G.; Egorov, A. I. Zh. Prikl. Spektrosk.; 15: No. 4, 737-8(Oct 1971). (In Russian).

A method is described for the isotopic analysis of water by the common SF-4 spectrophotometer, using the germanium photodiode FD-1. This arrangement permitted the determination of D_2O concentrations in mixtures containing 10 to 90% D_2O. (tr-auth)

35825 DETERMINATION OF CARBON IN A SODIUM COOLANT. Dmitrieva, I. B.; Kozlov, F. A.; Nalimov, Yu. P.; Kulikova, I. A.; Volin, I. K. This paper was summarized in At. Energ. (USSR); 30: No. 3, 297-8(Mar 1971) as paper No. 467/5772. (In Russian).

Full copy of this paper is held by TIC.

A method of determining the total carbon content, as well as separate determination of the content of free and carbonate carbon in a sodium coolant, using preliminary distillation of sodium under vacuum, is described. The design of the sample collector–distiller, permitting the collection and simultaneous distillation of up to seven samples of sodium weighing ~30 g each, is described. In an analysis for total carbon content, ignition of the residue to carbon dioxide is conducted after distillation in a flow of dry purified oxygen. Free carbon is determined after treatment of the residue with hydrochloric acid vapors to decompose sodium carbonate, convert sodium oxide to the chloride, and decompose the carbides of iron, chromium, and calcium. The separate determination of carbonate and free carbon in sodium is accomplished by heating the residue after distillation with sulfuric acid. The relative error in the determination of the carbon content was 24.5 and 6% after the introduction of 1 and 3 mg carbon, respectively.

The limiting sensitivity of the proposed method is ~4 · 10^{-4}% by weight. (auth)

35826 SIMPLE SPECTROPHOTOMETRIC METHOD FOR DETERMINATION OF ZIRCONIUM OR HAFNIUM IN SELECTED MOLYBDENUM-BASE ALLOYS. Dupraw, William A. (Lewis Research Center, Cleveland). Talanta; 19: No. 6, 807-10(Jun 1972).

A simple analytical procedure is described for determining zirconium or hafnium in molybdenum-base alloys by formation of the Arsenazo III complex of zirconium or hafnium in 9M hydrochloric acid. The absorbance is measured at 670 nm. Molybdenum (10 mg), titanium (1 mg), and rhenium (10 mg) have no adverse effect. No prior separation is needed. The relative standard deviation is 1.3 to 2.7%. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 36170 and 36171.

35827 (CEA-R-4265) DETERMINATION OF FISSION NEODYMIUM IN IRRADIATED FUELS. Frejaville, Gerard; Lucas, Monique (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan 1972. 30p. (In French). Dep. NTIS (U. S. Sales Only).

An isotopic dilution method to determine fission neodymium in irradiated fuels is described. This element characterizes the number of fissions that have occurred. The work was based on an ASTM norm subjected to investigation; it recommends the use of a triple tracer ^{150}Nd, ^{242}Pu, ^{233}U to obtain a simultaneous determination of the ratios ^{238}U/^{239}Pu and ^{148}Nd/^{238}U in the fuel. This principle was adapted to French nuclear fuels at present being analyzed. The study led to the drawing up of a precise mode of operation applicable to routine analyses. The changes made to the apparatus and to the operational conditions and the preparation and calibration of the triple tracer are described. This method was successful for analysis of 40 fuels of burnup rates between 400 and 10,000 MWd/T. The relative precision of the results obtained is discussed; it can be estimated at ±2%. (auth)

35828 (CEA-R-4334) DEVELOPMENT OF A TECHNIQUE FOR THE DETERMINATION OF THE SPECIFIC ACTIVITY OF β AMINO-ISOBUTYRIC ACID IN URINE. Geronimi, Claude; Gava, Pierre; Robert, Monique (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr 1972. 20p. (In French). Dep. NTIS (U.S. Sales Only).

The technique proposed enables the elimination of tritium- or carbon-14-labeled BAIB into the urine to be established. A crude extract obtained by resin chromatography is hydrolyzed and desalted, and then subjected to two successive chromatographic separations using the automatic Technicon TSM1 apparatus, the elution being carried out with different pH gradients in order to isolate the purified BAIB; part of the eluate is used for ninhydrine colorimetry, the remainder being used for activation measurements by liquid scintillation. The sensitivity limit may be as low as some pCi/μM of BAIB. The method is useful for the monitoring of personnel exposed to thymidine labeled in position 6 or methyl labeled with tritium or ^{14}C. (auth)

35829 (CONF-720319-1) APPROACH TO THE PROBLEMS ENCOUNTERED IN THE ELECTRON-PROBE ANALYSIS OF IRRADIATED FUEL SECTIONS. Bramman, J. I.; Yates, G.; Hughes, B. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). [1971]. 5p. Dep. NTIS (U. S. Sales Only).

From Conference on post-irradiation examination techniques; Reading, England (22 Mar 1972).

Many highly-active irradiated mixed oxide fuel samples were successfully examined using an extensively modified AEI SEM 2-electron-probe microanalyzer. The design philosophy underlying the modifications and the specially devised specimen preparation and handling techniques are discussed. During routine optical microscopic examinations of fuel pin sections, examples of fuel/clad interactions and second phase segregation are frequently seen. These cannot be investigated in an electron-probe microanalyzer without further preparation to reduce the specimen activity level and therefore it is not possible to examine the surface originally exposed without risk of damage. A reliable method of preparing 200 to 300 μm thick slices was devised and these permit analysis of a section lying within this distance of the original surface. Using such samples, the modified microanalyzer, operating with the original beam current, shows no significant loss of analytical sensitivity or accuracy. The instrument is not in a shielded enclosure so that analysis of inactive samples and routine maintenance work are unimpeded. (auth)

35830 (JUL-818-CA) RADIOSTRONTIUM ANALYSIS. I. SEPARATION AND DETERMINATION OF ^{89}Sr AND ^{90}Sr FROM GRAPHITE SAMPLES AND LEACH SOLUTIONS. MANUAL OF ANALYTICAL PROCEDURES. Stoeppler, M.; Cremer, M.; May, K. (Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse). Dec 1971. 55p. (In German). Dep. NTIS (U. S. Sales Only).

Details of all methods of sample preparation and of separation procedures for ^{89}Sr and ^{90}Sr from fission and activation products used in routine analyses together with the complexometric yield determination are described in detail. (auth)

35831 (JUL-819-CA) RADIOSTRONTIUM ANALYSIS. III. EVALUATION PROGRAM, TABLES OF DECAY AND BUILD-UP-FUNCTIONS FOR ^{85}Sr, ^{89}Sr, ^{90}Sr, AND ^{90}Y. Petri, H.; Stoeppler, M. (Kernforschungsanlage, Juelich (West Germany). Zentrallabor fuer Chemische Analyse). Dec 1971. 107p. (In German). Dep. NTIS (U. S. Sales Only).

A simple evaluation program for the determination of ^{90}Sr content of graphite samples from analytical data is described, followed by computer-calculated tables of decay-correction factors for ^{85}Sr, ^{89}Sr, ^{90}Sr, and ^{90}Y and a buildup correction table for ^{90}Y from ^{90}Sr after initial ^{90}Y/^{90}Sr separation. (auth)

35832 (K-1819) FIELD DETERMINATION OF ^{235}U ENRICHMENT BY PORTABLE GAMMA-RAY SPECTROMETRY. Flynn, A. R. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 5 May 1972. Contract W-7405-eng-26. 10p. Dep. NTIS.

A portable, solid-state, single-channel, gamma spectrometer has been used experimentally for the rapid field measurement of ^{235}U enrichment. The uranium was contained in UF_6 in cylinders and in impure uranium compounds in cans. The method involves measuring the ^{235}U peak at 185 keV, subtracting the background, and correcting for the Compton effect from higher-energy radionuclides. The gamma activity from ^{235}U in the sample is compared to the gamma activity from ^{235}U of known abundance in uranium references of similar uranium compounds in similar containers. The method can be used to assign large containers for which calibrating data are available to broad isotopic ranges or categories. (auth)

35833 (RISO-256, pp 85-97) ANALYSIS OF METALLIC ORES BY RADIOISOTOPE. EXCITED X-RAY FLUORESCENCE. Loevborg, L.; Kunzendorf, H. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.

In Aspects of research at Risoe.

The principles and techniques of x-ray fluorescence analysis using radioisotope excitation sources and energy-dispersive methods of x-ray detection are explained. The performance of the measurement method for the determination of metal contents in metallic ores is illustrated by examples, which include the use of portable equipment and semiconductor-detector x-ray spectrometers. (auth)

35834 USE OF RADIOISOTOPES IN THE ANALYSIS AND TESTING OF DRUGS. Maziere, B. (CEA, Orsay, France). Prod. Probl. Pharm.; 27: No. 1, 20-8(Jan 1972). (In French).

Different methods of radiochemical analysis are surveyed: direct, double, or substoichiometric isotope dilution analysis, radioactivation analysis, radiometric analysis, x-ray fluorescence, and neutron or γ ray analysis. After theoretically recalling the principles, the applications of radioisotope techniques to the analysis and testing of drugs are illustrated, examples of the use of radioactive tracers in pharmaceutical sciences being given. (France)

35835 ESTIMATION OF LOW-ENERGY β-NUCLIDES USING SILICON DETECTORS WITH PARTIALLY DEPLETED SURFACE BARRIER. I. ANALYSIS OF THE CONDITIONS FOR NUCLIDE RADIOACTIVITY MEASUREMENT. Tykva, R. (Inst. of Organic Chemistry and Biochemistry, Prague); Kokta, L.; Panek, V. Radiochem. Radioanal. Lett.; 10: No. 2, 71-81(14 May 1972).

The working conditions attainable during the radioactivity assay of a low-energy β nuclide by means of a partially depleted surface-barrier silicon detector without a guard ring were analyzed. The analysis was aimed at attaining a maximum figure of merit. The detection system under investigation is suitable for radioanalytical work with relatively small planar solid samples labeled with ^{14}C or ^{35}S, stable in vacuum. For the so-called infinitely thick layer of poly(methyl methacrylate-^{14}C), 20.7% of the negatrons emitted from the surface can be recorded at 293°K and a background of 0.4 cpm. (auth)

35836 DETERMINATION OF PLUTONIUM IN THE ENVIRONMENT BY EXTRACTION AND ALPHA COUNTING WITH A LIQUID SCINTILLATOR. Ghysels, J. P. (Nuclear Experiment Center, Lucens, Switzerland). Atomwirt., Atomtech.; 17: No. 2, 83-4 (Feb 1972). (In French).

The Pu determination described is a combination of two analytical techniques: a Pu extraction with a tertiary amine (triisooctylamine in xylene), and its return into aqueous solution by reduction with NH_4 I, followed by a novel extraction using 10% D2EHPA (diethylhexylphosphoric acid in toluene). The latter is finally mixed with a liquid scintillator for alpha counting. (K.S.W.)

35837 SCINTILLATION COUNTING: ADSORPTION AND SOLVATION PROBLEMS. Davison, Peter F.; Andersson, Lorna P. (Boston Biomedical Research Inst.). Anal. Biochem.; 47: No. 1, 253-63(May 1972).

Problems were encountered in accurately determining counting rates of basic tritiated compounds in several scintillation cocktails. These difficulties derived from adsorption losses. In addition, a significant difference in counting efficiency for hydrophilic and hydrophobic materials may be detected in some solutions; internal standardization may be unreliable in these situations. (auth)

35838 SURFACE CHARACTERIZATION OF STAINLESS STEEL USING PROTON-INDUCED X RAYS. Musket, R. G.; Bauer, W. (Sandia Labs., Livermore, Calif.). Appl. Phys. Lett.; 20: No. 11, 411-13(1 Jun 1972).

Proton-induced characteristic x rays (1 to 10 keV) were used to study, in situ, the alloy composition of 304L stainless steel surfaces as a function of the vacuum annealing temperature. Effects of 15-min isochronal vacuum anneals between 700 and 1450°K were determined by probing to depths of about 1 μm with 150- to 400-keV protons. In particular, chromium depletion was significant above 1200°K. For 200-keV protons, the $Cr(K_\alpha)/Fe(K_\alpha)$ ratio decreased from about 0.8 for 700 to 1200°K to 0.19 at 1450°K; this corresponds to a decrease in the chromium content from 19 to about 6 wt %. (auth)

35839 APPARATUS FOR WATER DETECTION USING A RADIOACTIVE TRITIUM LABELLED REACTANT. Gelezunas, Vincent L. (to General Electric Co.). U. S. Patent 3,655,982. 11 Apr 1972. Filed 29 Jan 1969.

A method and apparatus are described for detecting water using an appropriate radioactive labelled alkaline earth hydride as a reactant. Fluid from a gas, liquid, or solid sample to be tested is passed through a bed of the reactant. The water present in the sample reacts with the reactant forming a radioactive product whose radioactivity is then measured to give a quantitative determination of the amount of water in the sample or a qualitative determination of the presence of water. (Official Gazette)

35840 CHEMILUMINESCENCE IN DIOXANE-BASED SCINTILLATION FLUID. Moriarty, C. M. (Univ. of Nebraska, Omaha). Int. J. Appl. Radiat. Isotop.; 23: No. 5, 238-9(May 1972).

In studies on the determination of ^{45}Ca in serum-containing solutions, complications were encountered by way of very high background levels when using dioxane-based scintillators. It was found that this resulted from chemiluminescence of the system; the use of toluene-based counting solutions obviated this difficulty. Details are given for the preparation of the toluene-based scintillation fluid. The difficulty was not encountered with serum-free systems. Other reports of chemiluminescence in liquid scintillation counting are also mentioned, in some cases also obviated by the use of toluene. (UK)

Separation Procedures

Refer also to abstracts 35864, 35954, 35970, 35979, and 35989.

35841 (CEA-R--4295) NEW METHOD OF RE-EXTRACTING U FROM A TRIBUTYL PHOSPHATE OR A TRIDODECYLAMINE PHASE. Ravenel, Jacques; Soret, Christian (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Apr 1972. 42p. (In French). Dep. NTIS (U. S. Sales Only).

A process for re-extracting metallic elements from an organic solvent is described. Ion exchange resins are used. The case of U in tributyl phosphate, diluted in xylene is considered. The addition of an organic solvent miscible with the TBP–xylene mixture and water is proposed. The miscibility diagram for the system permits variable quantities of HCl to be added to the system. The solvent is generally an alcohol, in particular methanol. The solution obtained in this way is passed through a column of anion exchange resin, which retains the U. A 0.1 N HCl solution is used for the elution. A variation in the distribution coefficient with the resin mass was observed; an explanation of this phenomenon is suggested. An extension of this method treating the case of tridodecylamine is presented. (auth)

35842 FOAM SEPARATION OF ANIONS: STOICHIOMETRY. Grieves, Robert B.; Bhattacharyya, Dibakar (Univ. of Kentucky, Lexington). Separ. Sci.; 7: No. 2, 115-29(Apr 1972).

Experimental studies were carried out on the foam separation of I^-, $HCrO_4^-$, $S_2O_3^{2-}$, and $Ag(S_2O_3)_2^{3-}$ using a cationic surfactant as the collector–frother. The object of the work is the establishment of the stoichiometry of the foam-separated surfactant cation–anion product to gain some insight into the mode of interaction between the surfactant and the anion. The stoichiometry, S, defined as the ratio of the rate of surfactant removal to the rate of anion (colligend) removal at the gas bubble interfaces, ranges from 2.2 to 2.8 mole/mole (average values) for $S_2O_3^{2-}$, being a function of foaming time for the only system which does not involve the formation of particulates between the surfactant and the colligend. For $HCrO_4^-$, I^-, and $Ag(S_2O_3)_2^{3-}$, S is constant with foaming time and a particulate product is formed in the bulk solution and/or the froth. For $HCrO_4^-$, S is close to unity and is almost independent of the feed surfactant/colligend ratio, indicating minimum free surfactant. For I^-, S averages 1.3 and is a weak function of the feed ratio, indicating that free surfactant is significant. Steric effects or secondary adsorption or exchange of $Ag(S_2O_3)_2^{3-}$ onto the particulates makes S a linear function of the feed ratio. (auth)

35843 SOLVENT EXTRACTION AND SEPARATION OF ZIRCONIUM, NIOBIUM, AND TANTALUM BY 2-CARBETHOXY-5-HYDROXY-1-(4-TOLYL)-4-PYRIDONE. Janko, M.; Herak, M. J. (Univ., Zagreb). Mikrochim. Acta; No. 2, 198-207 (1972).

Extraction of zirconium, niobium, and tantalum from oxalic and hydrofluoric acid solutions using 2-carbethoxy-5-hydroxy-1-(4-tolyl)-4-pyridone (HA), indexed as the ethyl ester of 1,4-dihydro-5-hydroxy-4-oxo-1-(4-tolyl) picolinic acid, dissolved in chloroform was studied. A mechanism for the extraction of zirconium from oxalate solutions and of niobium from fluoride solutions is proposed. Separation of zirconium and niobium from oxalate solution as well as from fluoride solution and tantalum and niobium from fluoride solution is described. Back-extraction of these metals is possible using hydrofluoric and oxalic acids. Results obtained show that the efficiency of extraction by HA decreases in the sequence tantalum > niobium > zirconium. (auth)

35844 SEPARATION OF IODIDES, TELLURITES, AND TELLURATES BY EXTRACTION WITH ETHYL ACETATE–METHYL ISOBUTYL KETONE MIXTURES. Zmbova, B.; Bzenic, J. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). Anal. Chim. Acta; 59: No. 2, 315-18(Apr 1972).

Iodine is extracted from HCl solution in the presence of H_2O_2; tellurium(IV) is extracted from HCl and tellurium(VI) remains in the aqueous phase. An enhancement of the solvent extraction was observed when this mixture of organic extractants was used. Radioisotopes were used to measure the distribution coefficients. The procedure was used to determine tellurium(IV). (M.C.G.)

35845 SOLVENT EXTRACTION OF URANIUM(VI) WITH TRIOCTYLPHOSPHINE OXIDE IN THE PRESENCE OF AROMATIC CARBOXYLIC ACIDS. Mareva, S. (Inst. of General and Inorganic Chemistry, Sofia); Jordanov, N.; Konstantinova, M. Anal. Chim. Acta; 59: No. 2, 319-23(Apr 1972).

The effects of aromatic carboxylic acids on solvent extraction of uranium with TOPO were determined. The extraction curves involve two regions: a region of antagonistic action (pH 1 to 1.80) and a region of synergic action (pH >1.80). The antagonistic effect depends entirely on the acid concentration. The degree of synergic effect depends linearly on the pK values of the organic acids. (M.C.G.)

35846 DEPENDENCE OF THE EXTRACTION CAPACITY OF NEUTRAL ORGANOPHOSPHORUS COMPOUNDS ON THEIR STRUCTURE. III. INFLUENCE OF ANIONS. EXTRACTION OF URANYL CHLORIDE. Rozen, A. M.; Nikolotova, Z. I.; Kartasheva, N. A.; Zarubin, A. I.; Teterin, E. G. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 718-22(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 700-4(Sep-Oct 1971).

The extraction of uranyl chloride was studied in a series of neutral organophosphorus compounds TBP–TOPO at temperatures of 0 to 70°C. The effective extraction constants are approximately 600 times lower than for uranyl nitrate. There is a linear correlation between the logarithm of the constants and the characteristics of the structure of the extraction reagents. The thermal effects of extraction were measured and calculated according to the temperature dependence of the concentration constants. The calculated effects are not correlated with the characteristics of the structure and differ substantially from those measured directly. The concentration constants in this case are unsuitable for calculating the thermal effect. (auth)

35847 INVESTIGATION OF THE EXTRACTION OF U(VI) FROM CITRIC ACID SOLUTIONS WITH TETRADECYLAMMONIUM SALTS. Vdovenko, V. M.; Kuzina, M. G.; Lipovskii, A. A. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 723-6(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 705-9(Sep-Oct 1971).

The extraction of U(VI) with solutions of tetradecylammonium citrate and bromide in benzene from aqueous solutions containing citric acid was investigated. Depending on the pH of the equilibrium aqueous solution, two complex compounds were detected in the organic phase by different absorption spectra. On the basis of the data obtained, preliminary conclusions were drawn on the composition of the extractable compounds. (auth)

35848 INFRARED SPECTRA AND STRUCTURE OF URANYL COMPOUNDS FORMED IN EXTRACTION FROM CITRIC ACID SOLUTIONS. Lipovskii, A. A.; Kuzina, M. G. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 737-41(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 719-24(Sep-Oct 1971).

When solid uranyl citrate is dissolved in solutions of R_4NOH, depending on the ratio of the reacting components, two complex compounds of uranyl may be obtained. A comparison of the absorption spectra of solutions of R_4NUO_2Cit and $(R_4N)_4(UO_2)_3Cit_2(OH)_4$ with the spectra of the extracts shows that in the extraction of U(VI) from citric acid solutions with the aid of tetradecylammonium salts, depending on the pH of the aqueous phase, one of these compounds or a mixture of them is found in the organic phase. On the basis of a measurement of the ir spectra, hypotheses are advanced on the nature of the coordination of the citrate and hydroxyl groups to the uranium atoms. (auth)

35849 HYDROXIDE COLLECTORS IN RADIOCHEMISTRY. VI. STRUCTURAL PECULIARITIES OF THE STATICS OF SORPTION SYSTEMS IN WHICH HYDROXIDES PARTICIPATE. Egorov, Yu. V.; Puzako, V. D. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 764-8(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 747-51(Sep-Oct 1971).

Hydroxide collectors combine the characteristics both of heteropolar sorbents and of ampholites. Various theoretically possible modes of transition of a cationic impurity from solution into a hydroxide precipitate and those mentioned in the literature were compared and generalized: olation copolymerization followed by oxolation (“coordination coprecipitation”, primary sorption), ion exchange on terminal aqua- or hydroxyl groups, secondary sorption in the presence of potential determining sorption of hydroxyl ions. The processes are reduced to formally identical equations (S vs pH isotherms) in a static plan, since the hydroxides chemically include the solvent (water). Moreover, in a number of cases the difference between the results of primary and secondary sorption may disappear. (auth)

35850 RADIOCOLLOIDS IN SORPTION SYSTEMS. VII. SELECTION OF THE CATION-EXCHANGE RESIN FOR INVESTIGATING THE STATE OF MICROQUANTITIES OF IONS UNDERGOING HYDROLYSIS. Betenekov, N. D.; Puzako, V. D.; Egorov, Yu. V. Sov. Radiochem. (Engl. Transl.)· 13: No. 5, 769-72(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 751-4(Sep-Oct 1971).

On the basis of an analysis of the equation of the $\bar{\epsilon}$ versus pH isotherm, considering the variation of the acid properties of the organic ion-exchange resin and ionic strength of the solution, it was shown only when a cation-exchange resin for which the degree of ionization of the functional groups can be assumed equal to one in the investigated pH region is used can the nature of the $\bar{\epsilon}$ versus pH isotherm be unambiguously determined by the state of the sorbate—microcomponent. This conclusion is illustrated by comparison of the isotherms obtained using cation-exchange resins of different types, for microquantities of yttrium. (auth)

35851 RADIOCOLLOIDS IN SORPTION SYSTEMS. IX. REGION OF SORPTION HOMOGENEITY OF MICROQUANTITIES OF YTTRIUM. Betenekov, N. D.; Puzako, V. D.; Egorov, Yu. V. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 773-6(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 755-7(Sep-Oct 1971).

It was shown that an analysis of the sorption isotherms in systems with variable mass of the sorbent can give not only information on the region of existence of the microcomponent in nonhydrolyzed form, but also supplementary data on the nature of the restoration of intervariety equilibrium, disturbed by the introduction of the sorbent into the system. The region of practically complete existence of microquantities of yttrium in solutions of perchloric acid in the form of a hydrated triply charged cation was determined by the indicated method. It was established that even in a time significantly exceeding the time of establishment of empirical sorption, equilibrium between hydrolyzed varieties of yttrium is not entirely restored. (auth)

35852 SORPTION OF ^{90}Sr AND ^{45}Ca FROM SOLUTIONS WITH TITANIUM(IV) HYDROXIDE. Dolmatov, Yu. D.; Bulavina, Z. N.; Dolmatova, M. Yu. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 777-9(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 758-60(Sep-Oct 1971).

The dependence of the effectiveness of sorption on the structure of the sample was demonstrated by the method of static sorption of strontium-90 and calcium-45 ions from solutions on samples of titanium hydroxide produced by various methods. An explanation was proposed for the possible mechanism of the interaction. Amorphous titanium hydroxide, produced by alkaline hydrolysis in the cold from hydrochloric acid solutions of titanium(IV), may find use in radiochemical and ion-exchange practice. (auth)

35853 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF THE REACTIONS OF EXTRACTION OF URANYL NITRATES BY TRIALKYL PHOSPHATES IN INERT SOLVENTS. VI. TRI-n-HEPTYL PHOSPHATE (THpP). Shpunt, L. B.; Komarov, E V. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 784-6(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 763-5(Sep-Oct 1971).

The structure of the extractable complex of uranyl nitrate with THpP (tri-n-heptyl phosphate) was established. The thermodynamic constants of the extraction of uranyl nitrate by solutions of THpP in carbon tetrachloride and n-decane were determined at 10 to 50°C. The thermodynamic functions ΔH, ΔG, and ΔS were calculated according to the temperature dependence of the extraction constants $t = 25°C$. (auth)

35854 ION-EXCHANGE BEHAVIOR OF TRIVALENT AMERICIUM, CURIUM, AND PROMETHIUM IONS IN THE PRESENCE OF EDTA. Elesin, A. A.; Zaitsev, A. A. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 798-801(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 775-8(Sep-Oct 1971).

The complex formation of trivalent americium, curium, and promethium ions with EDTA was investigated by the method of ion exchange on the cation-exchange resin KU-2 under dynamic conditions in buffered medium created by ammonium α-hydroxyisobutyrate. The values obtained for the stability constants of the complexes at an ionic strength of 0.1 are correspondingly equal to: 17.14, 17.29, and 16.75. These data permit the results of potentiometric determination of the stability constant of complexes of rare earths and the results of ion-exchange separations of transplutonium elements and rare earth elements to be brought into agreement. (auth)

35855 NEW METHOD OF SEPARATION OF Bk(III) FROM Ce(III) ON AN ANION-EXCHANGE RESIN. Guseva, L. I.; Grigor'eva, S. I.; Tikhomirova, G. S. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 802-4(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 778-80(Sep-Oct 1971).

The influence of nitric acid (from 0.25 to 1.5 N) in the presence of 80% methanol or ethanol on the sorption of berkelium and cerium on an anion-exchange resin was investigated. The possibility of their separation in the investigated solutions was demonstrated; a better separation was obtained when methanol was used. The separation of Bk(III) and Ce(III) on the anion-exchange resin Dowex-1 × 4 with a solution of 0.5 N HNO_3 + 80% CH_3OH at a ratio $^{144}Ce/^{249}Bk = 5 \cdot 10^3$ (according to activity) in the presence of 2.2 mg of inactive cerium was studied. (auth)

35856 EXTRACTION OF NIOBIUM AND TANTALUM ON ANION-EXCHANGE RESINS AN-2F AND EDE-10P. Kuzhakhmetov, E. I. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 814-15(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 788(Sep-Oct 1971).

The possibility of sorption of niobium and tantalum of high purity on the anion-exchange resins AN-2F and EDE-10P was demonstrated. Complete regeneration of the anion-exchange resins AN-2F and EDE-10P was achieved when a solution of ammonium chloride was used for desorption. Niobium pentoxide corresponding to the technical specifications for piezotechnics was obtained experimentally. (auth)

35857 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF REACTIONS OF EXTRACTION OF URANYL NITRATE BY TRIALKYL PHOSPHATES IN INERT SOLVENTS. VII. TRI-n-OCTYL PHOSPHATE (TOP). Shpunt, L. B.; Komarov, E. V.; Pushlenkov, M. F. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 787-9(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 766-8(Sep-Oct 1971).

The structure of the extractable solvate of TOP (trioctyl phosphate) with uranyl nitrate was established. The thermodynamic equilibrium constants of the extraction of uranyl nitrate by solutions of TOP in carbon tetrachloride and n-decane were determined at 10 to 50°C. The thermodynamic functions of the extraction reaction: ΔH, ΔG, and ΔS were determined at $t = 25°C$. (auth)

35858 SEPARATION OF ELEMENTS BY EXTRACTION WITH O,O,S-TRIETHYL DITHIOPHOSPHATE. Busev, A. I.; Rodionova, T. V.; Verbitskaya, N. I. (Moscow State Univ.). Anal. Lett.; 5: No. 4, 237-41(1972). (In German).

The solvent extraction of niobium(V), tungsten(VI), titanium(IV) by O, O, S-triethyldithiophosphate (indexed as the O, O, S-triethylester of phosphorodithioic acid) and hydrochloric acid was studied. Tungsten(VI) extracts as a $WO_2Cl_2 \cdot (C_2H_5O)_2P(S)SC_2H_5$. The separation of molybdenum(VI) from niobium(V) and titanium (IV) is described. (auth)

35859 EXTRACTION OF PYROPHOSPHATE COMPLEXES OF RARE EARTH ELEMENTS. Shevchuk, I. A.; Tarasenko, L. E. (Donetsk State Univ., USSR). Zh. Anal. Khim.; 27: No. 3, 601(Mar 1972). (In Russian).

Pyrophosphate complexes of the rare earth elements can be extracted with primary high-molecular-weight alkylamines. (auth)

35860 USE OF N-CINNAMOYLPHENYLHYDROXYLAMINE IN ANALYTICAL CHEMISTRY. COMMUNICATION 4. THE SEPARATION OF TITANIUM, ZIRCONIUM, AND THORIUM. Kulumbegashvili, V. A.; Ostroumov, E. A. (Inst. of Oceanology, Moscow. Tbilisi State Univ., USSR). Zh. Anal. Khim.; 27: No. 3, 468-72(Mar 1972). (In Russian).

Thorium is not precipitated under conditions of quantitative precipitation of titanium and zirconium by means of N-cinnamoylphenylhydroxylamine. Thus, thorium can be separated from the metals in question. N-cinnamoylphenylhydroxylamine precipitates thorium quantitatively from 4N-HCl solution in the presence of $(NH_2)_2C_2O_4$ and $(NH_4)_2SO_4$; zirconium is not precipitated under such conditions. A method was developed for separation of titanium, zirconium, and thorium by means of N-cinnamoylphenylhydroxylamine when these metals are present in the same sample. (auth)

35861 PROCESS FOR THE SEPARATION OF ZIRCONIUM AND HAFNIUM. Otsuka, Takeshi (to Nippon Mining Co., Ltd.). U. S. Patent 3,658,466. 25 Apr 1972. Priority date 16 Aug 1967, Japan.

The separation of zirconium and hafnium is carried out by contacting countercurrently a kerosene solution of a water-insoluble tertiary amine and a monohydroxyl alcohol having a dielectric constant of less than 15 with an acidified aqueous solution of zirconium and hafnium containing sulfate ion. Substantially all of the zirconium contained in the aqueous solution is extracted preferentially into the kerosene solution. The kerosene solution thus loaded with zirconium, and also containing a small amount of hafnium, is back extracted with a dilute aqueous sulfuric acid solution to remove the hafnium. Zirconium is recovered by contacting the kerosene solution with an aqueous solution containing carbonate. (Offic. Gaz.)

35862 EXTRACTION OF NEODYMIUM BY NAPHTHENIC ACIDS. Mikhlin, E. B.; Mikhailichenko, A. I.; Berengard, I. B.; Klimenko, M. A. (State Scientific-Research and Planning Inst. of the Rare-Metals Industry, Moscow). Zh. Neorg. Khim.; 17: No. 2, 492-7(Feb 1972). (In Russian).

The extraction of rare earth elements by naphthenic acids was studied, using Nd as an example of their behavior. The composition of the extracted compound, and the degree of its polymerization in the organic phase were determined. Extraction constants were evaluated. (tr-auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 36527, 36528, and 36552.

Chemical and Physico-chemical Properties

Refer also to abstracts 35849, 35910, 35964, and 37776.

35863 INVESTIGATION OF BETA-BACKSCATTERING IN ORGANIC OXYGEN COMPOUNDS. Prokopowicz, K.; Szukhnik, A. (Institut fuer Kernforschung, Warsaw). Isotopenpraxis; 8: No. 1, 13-19(Jan 1972). (In German).

A concept of beta backscattering through orbital electrons was adopted on the basis of data gained from literature and from experimental work. It involved calculation of the increment of those atomic parameters that characterize the bond systems and free electron pairs in organic molecules. The oxygen mole fractions corrected according to this method as well as the sum of hydrogen and oxygen mole fractions with regard to organic oxygen compounds have a comparatively good linear correlation with beta-backscattering coefficients. (auth)

35864 COCRYSTALLIZATION OF MICROQUANTITIES OF RUBIDIUM AND CESIUM WITH POTASSIUM CHLORIDE FROM ACETONITRILE. Mikheev, N. B.; Rumer, N. A.; Ilyushchenko, O. N. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 760-1(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 745-6(Sep-Oct 1971).

A study of the cocrystallization of microquantities of rubidium and cesium with potassium chloride was conducted by the method of isothermal evaporation of solution. The distribution of the microcomponent between the crystalline phase and the solution obeys the Doerner–Hoskins equation. The effectiveness of the separation of the elements by the method of cocrystallization is mentioned. (M.C.G.)

35865 RADIOPROTECTING DRUG AND THE PREPARATION OF ITS PRINCIPAL INGREDIENT. (to Laboratoires Houde). French Patent 2,073,283. 1 Oct 1971. Filed 19 Dec 1969. (In French).

A drug used for the prevention and treatment of lesions due to ionizing radiations is described. It consists of a main active ingredient used alone or with the addition of a therapeutically administrable acid: (2-aminoethylthio)-2-methyl glycolate chlorhydrate. The drug can be administered buccally, parenterally, rectally, or locally. It is presented in the form of doses containing 100 to 500 mg of the main active ingredient (representing 1 to 10% by weight of the main active ingredient). The main active ingredient is made by reacting a compound: $HS-CH_2-CHR'-NH_2$ with an alcoyl glyoxylate: $OCH-COOR$ or a hemi-acetal ester: $RH-CHOH-COOR$ in the presence of an alcohol ROH and collecting the condensation product formed. (France)

35866 RAMAN SPECTRA OF VITREOUS, POLYCRYSTALLINE, AND MOLTEN BeF_2 TO 630°C AND THE INFRARED SPECTRUM OF VITREOUS BeF_2 AT 25°C. Quist, Arvin S.; Bates, John B.; Boyd, George E. (Oak Ridge National Lab., Tenn.). Spectrochim. Acta, Part A; 28: No. 6, 1103-5(Jun 1972).

Interest in BeF_2-containing melts as solvents for fissile and fertile fuel components for molten salt breeder reactors prompted an investigation of Raman spectra of solid and molten BeF_2 and the infrared spectrum of the solid. The vibrational spectrum of vitreous BeF_2 was found to be consistent with a model based on the structure of β-quartz. The Raman spectra of the high-temperature modification of crystalline BeF_2 and of molten BeF_2 contained single bands at 343 and 288 cm^{-1}, respectively. (auth)

Isotope Effects

35867 SOLVENT DEUTERIUM ISOTOPE EFFECTS IN ALCOHOLS. 1. RACEMIZATION OF PHENYL 2,2-DIPHENYLCYCLOPROPYL KETONE, 3-METHYL-4-PHENYL-2-BUTANONE, AND 2-METHYL-1-INDANONE. Levin, J.-O.; Rappe, C. (Umeaa Univ., Sweden). Chem. Scr.; 1: No. 5, 233-5(1971).

The racemization of three optically active ketones, phenyl 2,2-diphenylcyclopropyl ketone (1), 3-methyl-4-phenyl-2-butanone (2), and 2-methyl-1-indanone (3) in CH_3OH and CH_3OD with different bases was studied. The racemization of (1) in C_2H_5OH and C_2H_5OD and in $(CH_3)_3COH$ and $(CH_3)_3COD$ was also studied. Solvent deuterium isotope effects on the racemization of these ketones were found to be in the range 0.48 to 1.56, the solvent isotope effect defined as $\kappa_{ROH}/\kappa_{ROD}$. When bases of the alcoxide type were used the solvent isotope effect was found to be less than 1.0, and when bases of the amine type were used it was found to be 1.0 or greater than 1.0. These results are best explained on the basis of different strength in hydrogen bonding in the ground state and the transition state for the reactions at hand. (Sweden)

35868 DEUTERIUM AND ^{34}S ISOTOPE EFFECTS IN THE THERMAL DECOMPOSITION OF SOME CYCLIC SULFONES. Asperger, S.; Hegedic, D.; Pavlovic, D.; Borcic, S. (Inst. Rudjer Boskovic, Zagreb. Univ., Zagreb). J. Org. Chem.; 37: No. 11, 1745-8(2 Jun 1972).

The k_H/k_D ratios in the decomposition of 2,5-dihydrothiophene-2,2,5,5-d_4 1,1-dioxide (II) at 120° and 2,4-dimethyl-2,5-dihydrothiophene-5,5-d_2 1,1-dioxide (IV) at 105° were determined in the melt to be 1.094 ± 0.014 and 1.054 ± 0.019, respectively. The ^{34}S isotope effect in the decomposition of the undeuterated analog of II has also been measured in the melt and in the diethylene glycol diethyl ether solution and $^{32}k/^{34}k$ ratio found to be 1.009 at 99.5°. Both deuterium and ^{34}S isotope effects can well be accommodated by a concerted mechanism. The deuterium isotope effects are unusually small (about 3.3% per atom D extrapolated to room temperature). Possible explanations of this observation are mentioned. (auth)

35869 NITROGEN ISOTOPE EFFECTS ON THE CHYMOTRYPSIN-CATALYZED HYDROLYSIS OF N-ACETYL-L-TRYPTO-

PHANAMIDE. O'Leary, Marion H.; Kluetz, Michael D. (Univ. of Wisconsin; Madison). J. Amer. Chem. Soc.; 94: No. 10, 3585-9(17 May 1972).

The hydrolysis of N-acetyl-L-tryptophanamide catalyzed by α-chymotrypsin at 15.0° is accompanied by a nitrogen isotope effect of 1.006 at pH 6.73, 1.010 at pH 8.00, and 1.006 at pH 9.43. The step in which the carbon–nitrogen bond is broken must be at least partially rate controlling in the enzymatic reaction. The variation of the isotope effect with pH requires that there be an intermediate in the acylation of the enzyme in addition to those which have been observed previously. The pH dependence of these reactions is more complex than has previously been believed. (auth)

35870 SOLVENT ISOTOPE EFFECTS ON TETRAHYDRIDOBORATE HYDROLYSIS. Levine, Linda A.; Kreevoy, Maurice M. (Univ. of Minnesota, Minneapolis). J. Amer. Chem. Soc.; 94: No. 10, 3346-9(17 May 1972).

Part of the product of the first step of the acid-catalyzed hydrolysis of BH_4^- has been trapped as BH_3CN^-, which is stable at the pH used. This permits the evaluation of the isotopic composition of the H_2 produced in the first step of the four-step hydrolysis. The isotopic composition of the product of the first step was then compared with that of the solvent from which it was made. The isotope effect, $(k_H/k_D)_H$, is between 2.2 and 1.4. When the excess of H over D in the hydronium ion formed in an isotopically mixed solvent is taken into account, this leads to a primary isotope effect, $(k_H/k_D)_I$, of not more than 1.5. Since the overall kinetic solvent isotope effect is at least 1.5, the secondary solvent isotope effect, $(k_H/k_D)_{II}$, appears, unprecedentedly, to be equal to or greater than 1.0. This, and other experimental evidence, is reconcilable if the last step of the diffusion process, in which H_3O^+ comes into direct contact with BH_4^-, is considered to be rate determining. (auth)

35871 ERRATUM: NORMAL COORDINATE CALCULATIONS OF THE VIBRATIONS OF METHYLENE CYCLOPROPANE-h_6 AND -d_6. Bertie, J. E.; Sunder, S. (Univ. of Alberta, Edmonton). Can. J. Chem.; 50: No. 5, 765-8(1 Mar 1972).

A corrected set of values are given for the table, "Thermodynamic functions for C_4H_6 and C_4D_6 at 1 atm pressure and for the ideal gaseous state." (see NSA 25: 51440) (Canada)

35872 NON-BORN–OPPENHEIMER VIBRONIC COUPLING AND DEUTERIUM ISOTOPE EFFECT ON $T_1 \rightarrow S_0$ RADIATIVE TRANSITIONS OF AROMATIC HYDROCARBONS. Fischer, S. F. (Northwestern Univ., Evanston, Ill); Lim, E. C. Chem. Phys. Lett.; 14: No. 1, 40-5(1 May 1972).

Radiative lifetimes of the lowest triplet states were determined for several aromatic hydrocarbons from the measured fluorescence quantum yield, phosphorescence quantum yield, and lifetime of phosphorescence. It is found that the radiative lifetime is considerably longer for perdeuterated naphthalene and phenanthrene than for the corresponding perprotonated species. A theoretical explanation is presented which involves a new non-Born–Oppenheimer coupling mechanism. (auth)

35873 REACTION PATHS FOR BIMOLECULAR HYDROGEN EXCHANGE. Silver, D. M. (Johns Hopkins Univ., Silver Spring, Md.). Chem. Phys. Lett.; 14: No. 1, 105-7(1 May 1972).

Several reaction paths were examined from a quantum mechanical viewpoint to assess their likelihood to serve as reaction geometries for a concerted bimolecular hydrogen–deuterium exchange process. It is shown that along each of the paths, the system would be expected to encounter a high activation energy barrier consistent with the concept of a forbidden reaction path in the sense of Woodward and Hoffmann. The results are in accord with calculations of the corresponding potential surfaces. (auth)

35874 ESR SPECTRA OF MATRIX-STABILIZED HYDRONIUM RADICALS H_3O AND D_3O. Chuvylkin, N. D.; Zhidomirov, G. M. (Inst. of Organic Chemistry, Moscow). Chem. Phys. Lett.; 14: No. 1, 70-1(1 May 1972).

The results of INDO calculations do not support the discovery of the H_3O free radical. (auth)

35875 PREPARATION AND ACETOLYSES OF 5-DEUTERIATED exo-2-NORBORNYL-p-BROMOBENZENESULFONATES. Werstiuk, N. H.; MacDonald, R. R.; Ouwehand, R. W.; (and others) (McMaster Univ., Hamilton, Ont.). Can. J. Chem.; 50: No. 5, 618-26(1 Mar 1972).

Exo-deuterionorborneols containing deuterium in the various possible 5- and 6-positions were prepared and converted to the corresponding parabromobenzenesulfonates. Rates of acetolysis of the latter compounds in acetic acid–potassium acetate solutions were measured by an infrared-spectrophotometric method, and the isotope effects are given. The results indicate that the effect of deuterium at C-5 is nil, and that although deuterium at C-6 does show a significant effect, it does not matter whether the deuterium is in the endo or exo position; it is inferred that molecular rearrangement prior to acetolysis does not occur to a significant extent. (auth) (Canada)

35876 KINETICS OF ISOTOPIC EXCHANGE IN POLYHALOGEN AROMATIC SYSTEMS. I. EXCHANGE BETWEEN EOSIN AND BROMIDES IN ETHANOL. II. EXCHANGE BETWEEN ERYTHROSIN AND IODIDES IN ETHANOL. Marcopoulos, C. A.; Pertessis-Keis, M.; Georgopoulos, K. (Democritus Nuclear Research Center, Athens). Z. Phys. Chem. (Leipzig); 249: No. 1-2, 21-9(1972).

In order to investigate the reactivity of four halogen atoms of tetra derivatives of fluorescein, the isotopic exchange reactions between tetrabromofluorescein (FBr_4) and NH_4Br labeled with ^{82}Br and between tetraiodofluorescein (FI_4) and KI labeled with ^{131}I were studied in absolute ethanol. Runs were carried out between 45 and 60°C for a wide range of bromide or iodide and FBr_4 or FI_4 concentrations. To follow the increasing activity of the organic compound a butanol extraction procedure and a scintillation technique were adopted. The order of the reactions was determined and specific rates and Arrhénius parameters were calculated. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 35909.

35877 ISOTOPIC EXCHANGE OF URANIUM IN THE SOLUTION–SORBENT SYSTEM. Dement'ev, V. S.; Syromyatnikov, N. G.; Ostapova, N. V. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 750-5(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 733-9(Sep-Oct 1971).

A study of interfacial isotopic exchange of uranium between solutions and sorbents in contact with them (ion-exchange resins, aluminum oxide, and BAU charcoal) was undertaken. Depending on the composition of the solution, type of the sorbent, and conditions of contact, the values of the half-exchange periods $T_{\frac{1}{2}}$ at room temperature varied from $\sim$4 min to $\sim$4 h. The pH of the solution, as one of the basic indices of composition determining the state of uranium and the value of sorption, also influences the rate of isotopic exchange. The dependence of the rate of exchange on the pH is complex, reflecting changes in the state and mobility of uranium in solution. The opinion is expressed that the rate of exchange of dissolved and sorbed uranium is determined by the rate of diffusion in the "film," which is evidenced by a change in the value of the half-exchange period as a function of the rate of mixing and the composition of the solutions in contact with the sorbents. (auth)

35878 ISOTOPIC EXCHANGE OF MOLECULAR HYDROGEN IN DIMETHYL SULFOXIDE–WATER MIXTURES UNDER BASE CATALYSIS. Symons, E. A. (Atomic Energy of Canada Ltd., Pinawa, Manitoba); Buncel, E. J. Amer. Chem. Soc.; 94: No. 10, 3641-2(17 May 1972).

Dipolar media and correlations with acidity functions applicable to reaction rates in strongly basic solutions were used. The rate of isotopic exchange as a function of medium composition is shown. The rate of exchange increased by a factor of 10,000 as the medium composition was changed from purely aqueous to 99.5% DMSO. (M.C.G.)

35879 EXTRACTION OF DEUTERIUM FROM HYDROGEN GAS USING AMINES IN A BITHERMAL PROCESS. (to Atomic Energy of Canada Ltd.). British Patent 1,273,461. 10 May 1972. Priority date 8 Apr 1969, Canada.

A bithermal process for extracting D from H gas comprises passing the H-containing gas and a first exchange liquid (aliphatic amine with up to 5 C atoms per molecule, ammonia, or mixtures of these) through a hot region to cause D to be transferred from the first liquid stream to the H-containing gas and then passing the H-containing gas and a second exchange liquid (aliphatic amines with up to 5 C atoms per molecule, ammonia, and mixtures of these) different from the first exchange liquid through a cold region to cause the D to be transferred from the H-containing gas to the second exchange liquid stream. The first and second exchange liquid streams are then passed through a third region under conditions that allow countercurrent contacting of the two streams to cause D to transfer from the second to the first stream. (B.L.M.)

35880 EXTRACTION OF DEUTERIUM FROM AMMONIA SYNTHESIS GAS. (to Atomic Energy of Canada Ltd.). British Patent 1,273,462. 10 May 1972. Priority date 8 Apr 1969, Canada.

A bithermal process is described for the extraction of D from a gas stream containing H, D, and N. Ammonia, amines, or mixtures of these serve as exchange liquids. (B.L.M.)

35881 DEUTERIUM–HYDROGEN EXCHANGE USING DIAMINES. (to Atomic Energy of Canada Ltd.). British Patent 1,273,463. 10 May 1972. Priority date 8 Apr 1969, Canada.

A process for concentrating D from a H-containing gas comprises passing the gas at a predetermined temperature through an exchange liquid composed of a diamine having up to 5 C atoms per molecule to cause D transfer to take place between the gas and the liquid and then separating a portion of the D-enriched gas or liquid. (B.L.M.)

35882 PROCESS FOR THE CONCENTRATION OF THE STABLE ^{10}B AND ^{11}B ISOTOPES OF BORON. Stiehl, Gottfried; Gerstenberger, Heinz (to Deutsche Akademie der Wissenschaften, zu Berlin). British Patent 1,273,807. 10 May 1972. Filed 12 Sep 1969.

A countercurrent exchange process is described employing the following—an aqueous phase containing boric acid or an organoboric acid complex; an organic phase comprising an immiscible organic solvent, boric acid or an organo-boric acid complex, and a compound that forms salts or addition compounds with boric acid or with its complexes or that is able itself to form complexes with boric acid. The boron compounds in one of the phases reaching the end of the countercurrent apparatus are converted into the boron compounds of the other phase by appropriate chemical additions and transferred to this other phase, a part of each phase being reviewed for the separation of the ^{10}B- or ^{11}B-enriched boron compounds. The complexing organic compound may be tartaric acid, the organic solvent benzene, the salt or addition forming compound tri-n-octylamine, and the phase transferring or reversal compound dilute HCl for organic-aqueous transfer for tri-n-octylamine—benzene for aqueous—organic transfer. A relatively high separation factor is achieved, together with high throughputs. Equations are given for the liquid in the exchange process employed, utilizing tri-n-octylamine. The isotope ^{10}B is preferably concentrated in the organic phase and ^{11}B in the aqueous phase. A conventional mixer-settler apparatus may be employed, and the process is conducted at ambient temperature. (UK)

35883 FRACTIONATION OF CARBON ISOTOPES DURING THE PHYSICOCHEMICAL SYNTHESIS OF DIAMOND FROM A GAS. Fedoseev, D. V.; Galimov, E. M.; Varnin, V. P.; Prokhorov, V. S.; Deryagin, B. V. (Inst. of Physical Chemistry, Moscow. Moscow Inst. of Oil and Gas). Dokl. Akad. Nauk SSSR; 201: No. 5, 1149-50(11 Dec 1971). (In Russian).

Diamond synthesis from methane at a pressure of 0.2 to 0.5 torr was accomplished at 1,000 to 1,050°. Synthetic and natural diamond powders (1 μ diameter) were used as seed. Isotopic compositions were determined in a mass spectrometer. The ratio $^{13}C/^{14}C$ in the standard was $1,123.72 \times 10^{-5}$; the value of $\delta^{13}C$ in the original CH_4 was -4.62%. Passing the CH_4 through a liquid nitrogen trap did not alter this value. Special experiments showed that the carbon deposited from methane had the value $\delta^{13}C = -6.6\%$. Accordingly fractionation of the carbon isotopes had occurred. (K.S.W.)

35884 IMPROVED METHOD FOR PREPARING HEAVY WATER USING MONOTHERMAL ISOTOPIC EXCHANGE BETWEEN AMMONIA AND A SYNTHESIS GAS. Lesur, Pierre; Viratelle, Jean (to Societe Chimique des Charbonnages. Commissariat a l'Energie Atomique. l'Air Liquide, Societe Anonyme pour l'Exploitation des Procedes Georges Claude. Compagnie de Construction Mecanique, Procedes Sulzer). French Patent 2,074,737. 8 Oct 1971 Filed 22 Jan 1970. (In French).

An improved method of preparing heavy water by a monothermal type isotopic exchange between a synthesis gas and ammonia is described. The synthesis gas circulates countercurrent to liquid ammonia in a synthesis gas isotopic extraction tower; it is then sent into an ammonia-synthesizing unit in which the quantity of synthesis gas necessary to ensure the necessary liquid ammonia reflux in the isotopic extraction tower is transformed into liquid ammonia. (France)

35885 SIMULATION OF HYDRODYNAMIC PROCESSES IN THE SEPARATION OF ISOTOPES IN PACKED COLUMNS. Kaminskii, V. A.; Giorgadze, N. A.; Vartapetyan, R. Sh.; Dzhodzhya, M. P. This paper was summarized in At. Energ. (USSR); 30: No. 1, 48-9(Jan 1971) as paper No. 460/5459. (In Russian).

Full copy of this paper is held by TIC.

In order to obtain formulas for calculating hydrodynamic parameters of columns filled with an effective wire packing, the use of a geometrically simple model based on the statistical characteristics of actual packings is proposed. In the model the vapor moves in a narrow channel between two parallel surfaces inclined at some angle to the horizontal, while the liquid runs off as a film on the two interior faces of the channel. The width of the model is equal to the perimeter of the packing in a unit cross section of the column, while the space for the passage of the gas is determined from the condition that equivalent diameters in the packing and the model must be equal. For a packing consisting of segments of a triangular spiral used for the separation of boron, nitrogen, and carbon isotopes by chemical exchange and distillation, and also for the air—water system, good agreement between the calculated and experimental data was obtained. (M.C.G.)

35886 ELECTRICAL CONDUCTIVITY OF ION-EXCHANGE MEMBRANES IN SOLUTIONS OF URANYL SALTS. Laskorin, B. N.; Smirnova, N. M.; Mishukova, Yu. S. This paper was summarized in At. Energ. (USSR); 30: No. 3, 298(Mar 1971) as paper No. 469/5673. (In Russian).

Full copy of this paper is held by TIC.

The electric conductivity of cation—exchange membranes and anion-exchange membranes in hydrochloric, sulfuric, and nitric acid solutions of uranyl was studied. These solutions contain doubly charged UO_2^{2+} cations, and also more complicated ions formed as a result of complexing. The electric conductivity is determined at 20°C by measuring the resistance of membranes brought into equilibrium with the uranium solutions. In nitric and hydrochloric acid solutions the electric conductivity of anion-exchange membranes is greater than that of cation exchangers. In sulfuric acid solutions the anion-exchange membranes have a lower electric conductivity than cation exchangers. This is due to the presence of multiply charged anion complexes in sulfuric acid media. The electric conductivity of the cation-exchange membranes in the acids under consideration decreases on diluting the solution, since the hydrolysis of the uranyl ions then intensifies (the pH increases). As the acidity increased, there was a considerable rise in the electric conductivity of the membranes. (auth)

35887 EQUILIBRIUM DISTRIBUTION OF HYDROGEN ISOTOPES IN THE LIQUID–VAPOR SYSTEM FOR AMMONIA. Bakin, V. M.; Zel'venskii, Ya. D. This paper was summarized in At. Energ. (USSR); 30: No. 1, 47-8(Jan 1971) as paper No. 459/5809. (In Russian).

Full copy of this paper is held by TIC.

The separation factor for hydrogen isotopes in the liquid—vapor system for ammonia was measured in the 10 to 90°C range, using an instrument equivalent to one theoretical separation stage, by distilling off and analyzing specimens of the vapor phase which is in equilibrium with a large quantity of the liquid phase. On the basis of the concentration of the vapor and liquid phases in the equilibrium state, the separation factor of hydrogen isotopes in the liquid—vapor system was calculated as the ratio of the relative concentrations of deuterium in the liquid and vapor phases, respectively. In the temperature range under investigation, experiments did not indicate any inversion in α (which is assumed by some authors to exist at 75 to 85°C, on the basis of extrapolation of the data obtained in the temperature range from −70 to +20°C). Calculations using Eq. (1) indicate that $\alpha = 1$ at 118 to 119°C. (M.C.G.)

35888 IMPROVEMENTS IN OR RELATING TO ISOTOPIC HYDROGEN LABELLING. Garnett, J. L.; Hodges, R. J. (to Unisearch Ltd.). Australian Patent 417,394. 21 Sep 1971. Filed 26 May 1967.

A process is described in which organic compounds such as benzene, naphthalene, pyrene, and substituted equivalents are labeled with deuterium in an acidic medium using a soluble salt or complex of platinum as a catalyst. The acid and the Pt catalyst are selected so that there is no Pt precipitation during the homogeneous exchange, and so that no acid exchange reaction takes place to the exclusion of the catalysed reaction. (Australia)

Feed Materials Processing

Refer also to abstract 36051.

35889 MICROBIOLOGICAL LEACHING OF URANIUM. Duncan, D. W.; Bruynesteyn, A. (British Columbia Research Council, Vancouver). pp 55-61 of Selected Papers from 1970 Uranium Symposium. /Roman, Ronald J. (comp.). Socorro, N. Mex.; New Mexico State Bureau of Mines and Mineral Resources (1971).

From American Institute of Mechanical Engineering uranium symposium; Socorro, N. Mex. (6 May 1970).

The minerals studied contain U^{4+} and U^{6+}, with the latter soluble in H_2SO_4. Since extraction data suggest that the nonsoluble tetravalent form was solubilized, it must have oxidized to the soluble form. Bacteria could play two roles in this oxidation: direct oxidation or the intermediate role of replenishing supplies of ferric iron, which is known to perform the oxidation step. There is no evidence for direct oxidation, but the effect appears to be confined to regeneration of ferric iron and production of sulfuric acid. Laboratory studies indicated that the leaching area should contain an energy source, it should be kept damp but not flooded, it should be within the pH range 2 to 3, there should be adequate ventilation, and there should be a supply of ammonium sulfate and phosphate available to the bacteria. (M.C.G.)

Radiation Chemistry

Refer also to abstracts 35874, 35939, 35942, 35944, 35945, 35955, 35995, and 36637.

35890 (COO–3283-1) REACTIONS OF C^+ WITH ETHANE, ETHYLENE, AND ACETYLENE. Lindemann, Ellen; Rozett, R. W.; Koski, W. S. (Johns Hopkins Univ., Baltimore, Md. Dept. of Chemistry). [1971]. 19p. Dep. NTIS.

The ion-molecule reactions of $C^+(^2P)$ with ethane, ethylene, and acetylene in the gas phase were investigated over a projectile energy ranging from a few eV to 100 eV. Ions with one, two, and three carbon atoms and varying number of hydrogen atoms were observed. The behavior of the cross sections as a function of kinetic energy of the incident ion was used to infer the reaction mechanism. The energetics of the processes were the most dominant parameters determining the courses of the reactions. (auth)

35891 (RISO–256, pp 209-21) INVESTIGATION OF THE NH_2 RADICAL PRODUCED BY PULSE RADIOLYSIS OF AMMONIA IN AQUEOUS SOLUTION. Pagsberg, Palle B. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972. In Aspects of research at Risoe.

Hydroxyl radicals react with ammonia to form NH_2 radicals with a rate constant $k = 1.0 \times 10^8\ M^{-1}\ s^{-1}$. The ammonium ion is inert toward hydroxyl radicals. The NH_2 radical has a very weak absorption band at 530 nm with a band width of 200 nm and an extinction coefficient of $81\ M^{-1}\ cm^{-1}$. The spectral properties of the visible absorption band and the ultraviolet bands occurring simultaneously indicate that NH_2 radicals form charge transfer complexes with solvent and solute molecules. Hydrazine is formed with a maximum yield G = 2.7 by dimerization of NH_2 radicals, the rate constant being $2k = 4.4 \times 10^9\ M^{-1}\ s^{-1}$. Hydroxylamine is formed with a yield which goes through a maximum and a minimum with increasing ammonia concentration. The more important reaction at low ammonia concentrations is $NH_2 + OH \rightarrow NH_2OH$ with the rate constant $k = 9.5 \times 10^9\ M^{-1}\ s^{-1}$. At high ammonia concentrations $G(N_2H_4) = 2.7$ and $G(NH_2OH) = 0.7$, indicating that hydrogen peroxide is the precursor of the excess oxidation yield. It seems possible that the stoichiometric reaction $H_2O_2 + NH_3 \rightarrow NH_2OH + H_2O$ may proceed by a chain reaction with the radical NHOH as a chain carrier. The reactivity of NH_2 radicals toward H_2O_2, O_2, N_2H_4, and NH_2OH was investigated. The decay of NH_2 changed into pseudo first-order kinetics in the presence of H_2O_2 and O_2, corresponding to $k(NH_2 + H_2O_2) = 9 \times 10^7\ M^{-1}\ s^{-1}$ and $k(NH_2 + O_2) = 3 \times 10^8\ M^{-1}\ s^{-1}$, whereas the decay remained unchanged in the presence of N_2H_4 and NH_2OH. (auth)

35892 RATE CONSTANTS FOR REACTION OF HYDROGEN ATOMS WITH AROMATIC AND HETEROCYCLIC COMPOUNDS. THE ELECTROPHILIC NATURE OF HYDROGEN ATOMS. Neta, P.; Schuler, Robert H. (Carnegie-Mellon Univ., Pittsburgh). J. Amer. Chem. Soc.; 94: No. 4, 1056-9(23 Feb 1972).

Rate constants for the reaction of H atoms with aromatic and nitrogen heterocyclic compounds in aqueous solutions were measured by a steady-state in situ radiolysis–ESR method. The rate constants for the aromatic compounds investigated vary between 2.4 and $26 \times 10^8\ M^{-1}\ sec^{-1}$ and those for the heterocyclic compounds between 0.6 and $3.3 \times 10^8\ M^{-1}\ sec^{-1}$. Electron-donating substituents enhance the rate and electron-withdrawing groups retard the rate, qualitatively indicating an electrophilic character for the reaction. Correlation of the rate constants for a series of monosubstituted benzenes with Hammett's substituent constants shows a reasonably linear behavior ($\log k = 9.04 - 0.45\sigma$). Additivity of the σ constants was tested for the case of the acid form of the phenylenediamines and for the dicyanobenzenes. In the first instance the rate constants for all three isomers were found to be about one-half that for the anilinium ion, as expected from the Hammett plot. Additivity fails, however, in the case of the dicyanobenzenes where the rate constants for the three derivatives differ by a factor of two and those for the ortho and meta isomers are only slightly less than for cyanobenzene itself. In the case of pyridine the introduction of a nitrogen atom into the aromatic ring causes a considerable decrease in the rate constant. The effect of a second nitrogen atom is dependent on the position. The rate for pyrimidine is lower while the rates for pyridazine and pyrazine are higher than that for pyridine. These findings appear to reflect a reinforcement of the electron-withdrawing effect of the nitrogen atoms when they are in the 1 and 3 positions but a partial cancellation in the 1 and 2 or 1 and 4 positions. (auth)

35893 E.P.R. OF RADIATION-INDUCED RADICALS IN SULFUR- AND SELENIUM-AMINO ACIDS. Colombetti, G.; Monti, S. (CNR, Pisa, Italy). Int. J. Radiat. Biol.; 21: No. 4, 321-7(Apr 1972).

The formation and stabilization of free radicals in the following x-irradiated sulfur and selenium amino acids were investigated by electron paramagnetic resonance (E.P.R.): cystine (free base), cysteine (free base), methionine, ethionine, Se-cystine, Se-methionine, Se-ethionine. An attempt was made to identify the main radical species present. It was shown that selenium compounds had lower radical yields than those for sulfur compounds. An explanation is suggested for this difference. (auth)

35894 RADIATION-CHEMICAL SYNTHESIS OF GRAFT POLYMERIC MATERIALS WITH FUNGICIDAL PROPERTIES. Kabanov, V. Ya.; Voronkov, N. A.; Kochkin, D. A.; Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 200: No. 3, 628-9(21 Sep 1971). (In Russian).

Triethyl[(methacryl)oxy]tin was grafted onto polyethylene, polypropylene, poly(vinyl chloride), poly(ethylene terephthalate), polycaproamide, and some natural resinous products, using a radiation chemical method with ^{60}Co irradiation at a rate of 0.3 to 5 R/sec. The physicochemical properties of the polymers did not change. The grafted products were tested against seven fungi, but even after one year of solvent, sun, and water treatments, the fungicidal properties were retained. (K.S.W.)

35895 KINETICS OF THE DISSOLUTION OF IRRADIATED URANIUM OXIDES IN SULFURIC ACID. Gromov, V. V.; Medvedev, A. S. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 734-6(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 716-19(Sep-Oct 1971).

In a study of the action of γ, β, and n^0 irradiation on the rate of dissolution of U_3O_8, UO_3, and UO_2 in sulfuric acid, it was established that on the γ irradiation of U_3O_8 and UO_3, the passage of uranium into the liquid phase is reduced in the dose range 10^{19} to 10^{23} eV/g. Irradiation with β particles did not influence the behavior of the oxides in H_2SO_4 solution on account of the small depth of penetration of the β particles into the crystal lattice. Thermal neutrons, disrupting the structure of U_3O_8, sharply increased the rate of passage of uranium into 0.1N sulfuric acid. (auth)

35896 RADIATION-STABLE POLYAMIDE FIBER. Starkova, A. N.; Kirilenko, Yu. K.; Shapiro, E. I.; (and others). Sov. Radiochem. (Engl. Transl.); 13: No. 5, 810-11(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 785-6(Sep-Oct 1971).

The possibility of increasing the stability of polyamide fiber to γ irradiation by its chemical modification with ferrocene-containing compounds was determined. Ferrocene aldehyde was added to fibers and a stabilizing influence was observed. Increased resistance to both thermal and radiation effects and higher adhesion to rubber were the effects observed. (M.C.G.)

35897 RADIATION STABLE FERROCENE-CONTAINING POLY(VINYL ALCOHOL) FIBERS. Slatina, S. D.; Kirilenko, Yu. K.; Vol'f, L. A.; (and others). Sov. Radiochem. (Engl. Transl.); 13: No. 5, 812-13(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 786-7(Sep-Oct 1971).

Ferrocene-containing poly(vinyl alcohol) fibers were produced by impregnation of the freshly formed or thermostabilized fiber with a 5 to 18% solution of 1,1'-diacetylferrocene–formaldehyde resin (DAFF) in acetone. A substantial increase in strength and in elasticity under γ irradiation was observed. (M.C.G.)

35898 RADIATION–CHEMICAL OXIDATION OF HEXAVALENT PLUTONIUM INTO THE HEPTAVALENT STATE IN AQUEOUS ALKALINE SOLUTIONS. Zakharova, F. A.; Pikaev, A. K.; Orlova, M. M.; Gel'man, A. D.; Spitsyn, Vikt. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 3, 636-8(21 Nov 1971). (In Russian).

Solutions of Pu(VI) perchlorate containing 1M NaOH were saturated with N_2O and then irradiated in a linear electron accelerator (1.83×10^{16} eV/ml·sec), and the production of Pu(VII) was measured spectrophotometrically. The spontaneous reduction of the latter back to Pu(VI) was studied. In solutions containing O_2 the radioinduced oxidation of Pu(VI) did not occur. A mechanism for the latter process is proposed, and pertinent G-values are given. (K.S.W.)

35899 SECONDARY PROCESSES IN A SINGLE CRYSTAL OF PIMELIC ACID AFTER IRRADIATION. Colombetti, G.; Meloe, T. B. (Univ. of Oslo). Mol. Phys.; 23: No. 2, 377-92(Feb 1972).

The secondary processes, initiated by irradiation, taking place in a single crystal of pimelic acid ($HOOC(CH_2)_5COOH$) were investigated by an electron spin resonance technique. At 77°K only the $\dot{C}OOH$ and $\dot{C}H_2(CH_2)_4COOH$ radicals remain. Upon increasing the temperature the latter radical dissociates into short-lived products, and one of these products immediately captures a hydrogen atom from a neighboring undamaged molecule, leaving a radical $HOOC\dot{C}H(CH_2)_4COOH$. This radical then captures a hydrogen atom from another undamaged molecule, probably because it is brought somewhat out of its lattice equilibrium position. (auth)

35900 COMPOSITION OF PRODUCTS OF n-PROPANOL AND iso-PROPANOL RADIOLYSIS. Afanas'ev, A. M.; Kalyazin, E. P. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 1, 95-8(Jan-Feb 1972). (In Russian).

The composition of products of γ-radiolysis (^{60}Co) of liquid n-propanol and isopropanol was studied at 0°C. The yields of the main product and by-products were determined. (auth)

35901 IONIC REACTIONS LEADING TO THE FORMATION OF METHYL RADICALS IN GAMMA IRRADIATED GASEOUS ETHYLENE. Gawlowski, Janusz; Niedzielski, Jan; Sobkowski, Jerzy (Univ., Warsaw). Nukleonika; 16: No. 7-8, 349-58 (1971).

The formation of methyl radicals by an ionic mechanism in gamma radiolysis of xenon- and argon-sensitized gaseous ethylene was investigated. G_{CH_3} depends on the rare gas pressure and on the ethylene concentration. The results reveal that methyl radicals are formed by unimolecular dissociation of excited butene ions $C_4H_8^+$. The rate constant of this reaction depends strongly on the excess energy of the parent ethylene ions $C_2H_4^+$. (auth)

35902 APPLICATION OF THE SELF-ABSORPTION OF CHERENKOV LIGHT TO THE INVESTIGATION OF KINETICS OF INTERMEDIATES IN PULSE RADIOLYSIS. Zagorski, Zbigniew Pawel; Zimek, Zbigniew (Inst. of Nuclear Research, Warsaw). Nukleonika; 16: No. 7-8, 359-61(1971).

The system of Cherenkov self-absorption measurement was applied to a study of the pulse radiolysis of 10^{-4}M Fe^{2+} in aqueous 0.8N H_2SO_4 in equilibrium with air. The results show that the concept of measuring the progress of radiolysis during the high-intensity pulse is a useful one and that the measurement of kinetics is possible in a different and supplementary way. (D.H.M.)

35903 RADIOLYSIS OF WATER BY TRITIUM β RAYS: SCAVENGING OF HYDROGEN PEROXIDE PRECURSORS. Lemaire, G.; Ferradini, C.; Pucheault, J. (Centre Nationale de la Recherche Scientifique, Ivry, France). J. Phys. Chem.; 76: No. 11, 1542-6(25 May 1972).

The influence of OH radical scavengers (Cl^- and Br^-) on the yield of H_2O_2 formation in 0.4 M H_2SO_4 solutions irradiated by tritium β rays was measured. Comparison with the results obtained with γ rays shows differences which can be explained by the increase in the number of "short tracks" (in the terminology of Mozumder and Magee). (auth)

35904 PULSE RADIOLYSIS OF AQUEOUS THIOCYANATE SOLUTIONS. NATURE OF THE INTERMEDIATE TRANSIENT SPECIES. Behar, D.; Bevan, P. L. T.; Scholes, G. (Univ. of Newcastle upon Tyne, Eng.). J. Phys. Chem.; 76: No. 11, 1537-42(25 May 1972).

The pulse radiolysis of N_2O-saturated aqueous solutions of KCNS was studied under both neutral and alkaline conditions, and the optical absorption spectra of the precursors of the $(CNS)_2^-$ radical anion were obtained. In neutral solution the precursor has λ_{max}330 nm with ϵ_{330} 900 M^{-1} cm^{-1}, while in alkali it has a λ_{max}390 nm and ϵ_{390} 4600 M^{-1} cm^{-1}. Kinetic considerations lead to their assignment as CNS and $CNSOH^-$, respectively. The oxidation of CNS^- ions by OH radicals in these solutions is interpreted in terms of the reactions: $OH + CNS^- \rightarrow CNSOH^-$; $CNSOH^- \rightleftharpoons CNS + OH^-$, $K = 3.2 \times 10^{-2}$ M; and $CNS + CNS^- \rightleftharpoons (CNS)_2^-$, $K = 2 \times 10^5$ M^{-1}. The rate constant for the dissociation of $CNSOH^-$ was found to be $>5 \times 10^7$ sec^{-1}. In alkaline solutions, oxidation of CNS^- by O^- also takes place, viz., $O^- + CNS^- \rightarrow CNSO^{2-}$, $k = 3.7 \times 10^9$ M^{-1} sec^{-1}; $CNSO^{2-} + H_2O \rightleftharpoons CNSOH^- + OH^-$. Under the conditions used (up to 0.8 M NaOH) the doubly charged adduct is converted completely to $CNSOH^-$. (auth)

35905 RADIATION AND ULTRAVIOLET INDUCED ADDITION OF ALCOHOLS TO ETHYL CROTONATE. Tokuda, Masao; Yokoyama, Yuji; Taguchi, Toru; Suzuki, Akira; Itoh, Mitsuomi (Hokkaido Univ., Sapporo). J. Org. Chem.; 37: No. 11, 1859-61(2 Jun 1972).

Irradiation of ethyl crotonate or crotonic acid in an excess of alcohol with ^{60}Co γ rays gave the corresponding 3-methyl-4-alkyl-substituted γ-butyrolactones, small amounts of telomeric products of crotonate, and polymeric products. Photochemical addition of alcohols to trans-ethyl crotonate in the presence of benzophenone as sensitizer produced γ-butyrolactones, cis-ethyl crotonate, ethyl 3-butenoate, polymer, and other products. (D.H.M.)

35906 PULSE RADIOLYSIS STUDY OF POLYMERIZATION OF VINYLCARBAZOLE IN BENZONITRILE SOLUTIONS. Tagawa, Seiichi (Tokyo Univ.); Arai, Shigeyoshi; Kira, Akira; (and others). J. Polym. Sci., Part B; 10: No. 4, 295-9(Apr 1972).

The polymerization of vinylcarbazole in benzonitrile was studied using a microsecond pulse radiolysis technique. The identification and kinetic behavior of the reactive intermediates present are described. (B.L.M.)

35907 RADICALS IN γ-IRRADIATED POLY-3-METHYL-BUTENE-1. Kusumoto, Naoshi; Suehiro, Kazuaki; Takayanagi, Motowo (Kyushu Univ., Fukuoka). J. Polym. Sci., Part B; 10: No. 2, 81-6(Feb 1972).

ESR spectra were measured for γ-irradiated poly(3-methyl-1-butene) at various temperatures. The spectra indicate that more than two radical species decay in the temperature region studied with different decay rates. The radical species corresponding to the spectra are still unclear. (B.L.M.)

35908 ROLE OF CHARGED PARTICLES IN RADIATION INDUCED OXIDATIONS OF n-HEPTANE. Muratbekov, M. B.; Saraeva, V. V. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 1, 35-9(Jan-Feb 1972). (In Russian).

The effects of oxygen on the γ-radioinduced oxidation of n-heptane was studied in a wide range of concentrations. The results clearly indicated that oxygen can capture electrons at high concentrations (~0.1 mole/l). (auth)

35909 PREPARATION OF ^{36}Cl LABELED 2,4,5-TRICHLOROPHENOL BY EXCHANGE WITH $H^{36}Cl$ UNDER ^{60}Co IRRADIATION. Revilla, A. P.; Lubkowitz, J. A.; Parker, W. C. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Radiochem. Radioanal. Lett.; 10: No. 2, 131-7(14 May 1972).

The preparation of 2,4,5-trichlorophenol (TCF) labeled with ^{36}Cl is described. The method consists in irradiating a solution of TCF and $H^{36}Cl$ with γ rays. (auth)

35910 COLLOIDAL COMPOSITION AND METHOD OF PREPARING THE SAME. Lorina, John; Aluisy, G. Ronard; Loud, Norman D.; Rines, Robert H. (to Allor Corp.). British Patent 1,270,410. 12 Apr 1972. Filed 25 Sep 1969.

It is known that small concentrations of certain irradiated colloidal heavy metals, in a suitable carrier, possess powerful bactericidal, irritation dissipating, and similar curative properties. A new and improved composition of this type is described, together with the method of preparation and use. Suitable metals are Pt, Pd, Rh, Cu, Ru, Os, Ir, Tb, Pr, Ce, Th, Pa, U, Hf, W, V, Re, Zn, Cd, Hg, Au, and Ag, with the colloidal particles mainly in the size range 10^{-5} to 10^{-6} cm. The particles should be substantially unclustered, and the metal concentrations should be about 1.5×10^{-3} g/cm^3; irradiation causes the particles to remain unclustered in colloidal form. The metal or metals may be present in chelate form with an alkaloid of the strychnine family or a reserpine alkaloid. Irradiation may be with γ- or x radiation. Examples are given, and a graph is presented showing the relative kill efficiency for Staphylococcus aureus, Escherichia coli and Bacillus subtilis for a number of these compositions. Physiological action and mechanisms are discussed. (UK)

35911 NANOSECOND PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS CONTAINING PROTON AND HYDROXYL RADICAL SCAVENGERS. Buxton, G. V. (Univ. of Leeds, Eng.). Proc. Roy. Soc. (London), Ser. A; 328: No. 1572, 9-21(2 May 1972).

The time dependence of $G(e_{aq}^+)$ in the early stages of the radiolysis of water was investigated using nanosecond pulse techniques by studying the effects of added solutes that remove $H_3O_{aq}^+$ and OH. In pure water $G(e_{aq}^-) = 3.6$ at 7.5 ns and 2.8 at 120 ns after a 5 ns electron pulse. Successive addition of 1 mol OH^-/l and 1 mol CH_3OH/l increased $G(e_{aq}^-)$ at the earlier time to 4.45 and 5.95, respectively. 1 mol I^-/l had virtually no effect, and 1 mol Cl^-/l only a slight effect, on $G(e_{aq}^-)$ in neutral water, and 1 mol HCO_2^-/l had no effect at pH 14. From these results it was concluded that (i) $G_{e_{aq}^-}^0$ is not less than 5, (ii) G_H^0 is close to zero, and (iii) in the expanding spurs $e_{aq}^- + e_{aq}^-$ occurs between 10^{-8} and 10^{-7} s with $\Delta G(e_{aq}^-) = 0.6$, $e_{aq}^- + OH$ takes place between 10^{-9} and 10^{-8} s with $\Delta G(e_{aq}^-) = 0.5$, and $e_{aq}^- + H_3O_{aq}^+$ is predominant between 10^{-11} and 10^{-9} s, is 80% complete in 10^{-8} s, and complete in 10^{-7} s with $\Delta G(e_{aq}^-) = 1.1$. Thus the data are in good agreement with the diffusion model and indicate that neither dry charge recombination nor direct excitation of water plays a significant role in the radiolysis of water. (auth)

35912 ELECTRON SPIN-LATTICE AND CROSS RELAXATION IN IRRADIATED MALONIC ACID. Dalton, L. R. (Harvard Univ., Cambridge, Mass.); Kwiram, A. L.; Cowen, J. A. Chem. Phys. Lett.; 14: No. 1, 77-81(1 May 1972).

Electron spin−lattice and cross relaxation processes in X- and electron-irradiated single crystals of malonic acid were investigated over the temperature range 1.1 to 300°K as a function of radiation dosage and as a function of thermal aging. The recovery of the longitudinal magnetization following pulsed saturation is due to cross relaxation among the radicals $R_2\dot{C}X$, $R\dot{C}X_2$, and $R\dot{C}X_2C = O$ (where R = COOH or COOD and X = H or D) and to the characteristic spin−lattice relaxation rates of these radicals. The spin−lattice relaxation times in these radicals appear to be determined by phonon modulation of the spin−orbit coupling rather than of the hyperfine interaction. (auth)

35913 FROEHLICH POLARON MODEL FOR TRAPPING OF COMPTON ELECTRONS IN HYDROGEN-BONDED GLASSES. Ratner, M. A. (New York Univ., N. Y.); Sabin, J. R. Chem. Phys. Lett.; 14: No. 1, 92-4(1 May 1972).

The applicability of the Fröhlich polaron model to Compton electrons trapped in polar alcoholic glasses is discussed. The agreement of the properties deduced from the model with experiment is noted, and further experiments to test the applicability of the model are suggested. (auth)

35914 ABSORPTION SPECTRA OF IRRADIATED FILMS OF POLYVINYL CHLORIDE COATED WITH PERYLENE. Ueda, Hisashi; Yashiro, Dairokuro (Government Chemical Industrial Research Inst., Tokyo). Radiat. Res.; 50: No. 2, 276-83(May 1972).

The visible and uv spectra of γ-irradiated films of poly(vinyl chloride) doped or coated with perylene were recorded. These films were irradiated either under a vacuum, in N_2O or in NH_3. In the case of a film the surface of which was coated with perylene, an absorption maximum at 560 mμ was observed. When the same film was irradiated in N_2O, this absorption maximum was also observed. However, when it was irradiated in NH_3, this absorption maximum was not observed. In the case of a film in which perylene was dissolved, this 560 mμ absorption maximum was not observed, either. As the absorption maximum at 560 mμ coincided with that of perylene cation already reported, it was concluded that the perylene cation forms only on the surface of a film of poly(vinyl chloride). As the absorption of the energy of the γ ray takes place on the surface of the film at the same rate, per electron density, as that inside the film, it was concluded that the stabilization of the perylene cation, the precursors of which can migrate throughout the film, occurs only on the surface of polymer film. (auth)

35915 FREE RADICALS IN PYRIMIDINES. AN ESR-STUDY OF ELECTRON-IRRADIATED SINGLE CYRSTALS OF 5-NITRO-6-METHYLURACIL AT 77°K. Sagstuen, Einar; Meloe, Thor B.; Henriksen, Thormod (Univ. of Oslo). Radiat. Res.; 50: No. 2, 261-75(May 1972).

Single crystals of 5-nitro-6-methyluracil were irradiated at 77°K and studied at this temperature with electron spin resonance techniques. The resonance pattern yielding a triplet of doublets was ascribed to hyperfine interactions between the unpaired electron and a nitrogen and a proton, respectively. It is suggested that the radical responsible for this resonance is formed by abstraction of a hydrogen atom from N(1) leaving the unpaired spin density mainly in the molecular σ-core. In this σ-radical N(1) is responsible for the triplet and the hydrogen atom bound to N(3) for the doublet. A small methyl group splitting as well as INDO molecular orbital calculations for a number of different radical candidates were essential for this interpretation. The radical seems to exist in two slightly different conformations. (auth)

35916 GLUTATHIONESULFONIC ACID, THE PREDOMINANT PRODUCT OF X-RADIOLYSIS OF AIR-SATURATED SOLUTIONS OF OXIDIZED GLUTATHIONE. Owen, Terence C.; Wilham, Antony C. (Univ. of South Florida, Tampa). Radiat. Res.; 50: No. 2, 253-60(May 1972).

Glutathionesulfonic acid is identified as the sole product of exposure of dilute, air-saturated aqueous solutions of the hexapeptide disulfide oxidized glutathione to doses of x rays sufficient to destroy up to 80% of the starting material. The radiation-chemical yields are similar to those of cysteic acid from cystine and taurine from cystamine under similar conditions and exhibit concentration dependence similar to that shown by these simpler disulfides. Qualitative interpretation of the results is consistent with the proposal that the initiating step is electron abstraction from the disulfide giving a cation radical. (auth)

35917 REDUCED PRODUCTS AND HYDROGEN FROM X-IRRADIATED AIR-SATURATED SOLUTIONS OF CYSTAMINE AND CYSTINE. Owen, Terence C.; Wilbraham, Antony C.; Roach, John A. G.; Ellis, David R. (Univ. of South Florida, Tampa). Radiat. Res.; 50: No. 2, 234-52(May 1972).

Hydrogen, in excess of track yields, and thiol are found in acidic cystamine sulfate solutions exposed, in air, to x rays. These products are not found in basic solutions. Earlier work had shown that alkaline air-saturated cystamine solutions give sulfonic acid (taurine) in amounts numerically close to G_{OH}. Hydrogen peroxide in excess of track yields by amounts equal to $\frac{1}{2}$ G_H was also found. Acidic solutions, however, give considerably more sulfonic acid at intermediate disulfide concentrations and no excess peroxide. The results indicate the extra sulfonic acid, above G_{OH}, arises from oxidation by H, in part directly (possibly as H_2^+) and in part via HO_2. The latter part decreases steadily at higher disulfide concentrations as H is scavenged by disulfide, giving thiol, rather than by O_2. Cystine, in neutral or acidic solution, gives sulfonic acid yields no greater than G_{OH}. Concomitant hydrogen peroxide yields are near $\frac{1}{2}$ G_H. Accordingly, no hydrogen (except track yields) and little thiol are found even in acidic air-saturated cystine solutions after irradiation. Cystine, it seems, is not oxidized by $H(H_2^+)$ or HO_2 and scavenges H, giving thiol, relatively poorly. At high cystamine concentrations, in basic solution, sulfonic acid yields fall and a new species, possibly sulfenate ($R-S-O^-$), is produced. A novel procedure for determining radiolytic hydrogen is described. (auth)

35918 PURIFICATION OF WASTE WATERS BY GAMMA RADIATION. Chryan, M. B.; Vartan'yants, S. A.; Arshakuin, R. G. Tsvetov. Metal.; No. 1, 22-3(Jan 1972). (In Russian).

Accelerated purification of industrial waste waters from Cu−Mo tailings occurred when exposed to ^{60}Co gamma radiation. The optimum conditions were a dose level of 5 R/sec, and a total dose of 1,500 R. Preliminary calculations are given for an installation capable of handling 60,000 m^3/day; the activity requirement amounted to 1.6×10^6 Ci. (tr-auth)

35919 STRUCTURAL DISTURBANCES IN LYSOZYME AND RIBONUCLEASE A IN THE DRY FORM AFTER γ-IRRADIATION. Kaverzneva, E. D.; Maksimov, V. I.; Osipov, V. I. (Inst. of Organic Chemistry, Moscow). Biophysics (USSR) (Engl. Transl.); 16: No. 4, 601-9(1971).

Translated from Biofizika; 16: No. 4, 581-8(1971).

The effect of γ irradiation doses of 30 Mrad was studied in dry lysozyme and ribonuclease A. Changes in the dispersion of optical rotation, the fluorescence spectra, the ultraviolet spectra, the content of tryptophan and other amino acids before and after fractionation of irradiated lysozyme were determined. The tertiary structure of lysozyme was disturbed on exposure to radiation considerably less than the structure of ribonuclease. At identical doses of 30 Mrad the latter showed signs of general conformational disturbance, whereas the changes in lysozyme were of a more local character. The causes of the greater stability of lysozyme are discussed in relation to its structure. Fall in the content of tryptophan in lysozyme after γ irradiation was established by the colorimetric method without destruction of protein chromatographically after deep enzymatic hydrolysis, and from the study of the ultraviolet and fluorescent spectra. It was found that a number of properties in total irradiated lysozyme and the two fractions obtained from it by salting out did not display additivity (d.o.r. constants, ultraviolet spectra, content of trypotophan). The depth of the deviations from the native state was intensified after fractionation. It is suggested that on γ irradiation of lysozyme in the dry form, ionization occurs together with primary changes in the state of the molecule without significant structural disturbances. Only on subsequent dissolution and fractionation of the enzyme will chemical changes occur in the tryptophan residues and various conformational rearrangements. (UK)

35920 UNSTABLE INTERMEDIATES. PART 110. HYPERCONJUGATION BY GROUPS CONTAINING HEAVY ATOMS: ELECTRON SPIN RESONANCE STUDIES OF CARBON RADICALS HAVING β-SnR_3,-PR_2,-PR_3^+,-AsR_2,-AsR_3^+, AND -AsO_3H GROUPS [γ-IRRADIATION]. Lyons, A. R.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Faraday Trans., II; 68: No. 4, 622-30(1972).

ESR spectral studies of radicals from the γ irradiation of fine powders or glassy beads of tetra-n-butylphosphonium bromide, tetramethylphosphonium iodide, triphenylethylphosphonium iodide, tetra-n-butyltin, triethylphosphine, tri-n-butylphosphine, triethylarsine, tetraethylarsonium iodide, tetraethyltin, tetraethylgermane, tetramethyltin, n-propylarsonic acid, and sodium methylarsonate are reported. Hyperfine coupling to β-atoms such as Sn, P or As in carbon π-radicals is found to be remarkably large, corresponding to as much as 6% delocalization into the valence s orbital on the heavy atom. The radicals all have a preferred conformation in which the metal atom is constrained above the radical plane, so that overlap between the carbon 2p orbital nominally containing the unpaired electron, and the carbon-metal σ-bond orbital is a maximum. This magnetic interaction is shown to be about four times larger than that for similarly placed $-CR_3$ or $-NR_3^+$ groups. These observations are linked with those of others on rate enhancements by CH_2X groups in electrophilic aromatic substitution. They are also significant with respect to the stereochemical course of some olefin additions. (auth)

35921 γ- AND ULTRAVIOLET-RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF MALEIMIDE IN A FEW BINARY SYSTEMS. Hayakawa, Kiyoshi; Yamakita, Hiromi; Kawase, Kaoru (Government Industrial Research Inst., Nagoya, Japan). J. Polym. Sci., Part A-1; 10: No. 5, 1363-75(May 1972).

The solid-state polymerization of maleimide by γ and ultraviolet irradiation was carried out in binary systems with succinimide, maleic anhydride, and acenaphthylene. Polymaleimide obtained from the solid-state polymerization of maleimide by γ rays was amorphous, while that obtained from the solid-state polymerization by ultraviolet rays was highly crystalline. In the maleimide–succinimide system the rate of polymerization reached a maximum nearly at the eutectic composition when the polymerization was carried out by γ irradiation. With ultraviolet irradiation the rate of polymerization became higher with increasing content of succinimide in the feed. In the maleimide–maleic anhydride system a copolymer of both constituents was formed by γ irradiation, but almost no homopolymer was produced. On the other hand, two kinds of polymers, a crystalline copolymer and an amorphous one, were produced by ultraviolet irradiation. The results were compared with those obtained from the copolymerization in solution. In the maleimide–acenaphthylene system the main products with ultraviolet irradiation was the dimer of acenaphthylene. (auth)

35922 MOLECULAR WEIGHT DISTRIBUTIONS IN RADIATION-INDUCED POLYMERIZATION. IV. A COMPREHENSIVE KINETIC SCHEME FOR POLYMERIZATION IN THE LIQUID STATE. Westlake, John F.; Huang, Robert Y. (Univ. of Waterloo, Ont.). J. Polym. Sci., Part A-1; 10: No. 5, 1429-41(May 1972).

A comprehensive kinetic scheme is proposed which takes into consideration γ-ray-initiated polymerization via free radical, cationic, or radical-cationic species, or their combinations, and the relative contribution of each depending upon experimental conditions. From this kinetic model, equations describing the kinetics of polymerization and the resulting molecular weight distributions have been derived. The resulting expressions are complex in nature, particularly for the case where a combination of mechanisms is involved. In view of this, a general approach to the problem of generating theoretical molecular weight distributions based on the application of high speed digital computers was presented. The proposed technique is particularly powerful since no simplifying assumptions or mathematical approximations are required in order to obtain the molecular weight distribution. (auth)

35923 MOLECULAR WEIGHT DISTRIBUTIONS IN RADIATION-INDUCED POLYMERIZATION. V. A SIMULTANEOUS KINETIC AND MOLECULAR WEIGHT DISTRIBUTION ANALYSIS OF THE LIQUID-STATE POLYMERIZATION OF STYRENE. Westlake, John F.; Huang, Robert Y. (Univ. of Waterloo, Ont.). J. Polym. Sci., Part A-1; 10: No. 5, 1443-66(May 1972).

The γ-ray-initiated polymerization of styrene in the liquid state was investigated over the temperature range 0 to −29°C at constant dose rate. The kinetics and molecular weight distributions were studied for samples prepared by standard techniques and samples subjected to exhaustive drying to remove residual water. In the former case, the rates of reaction were comparable to those for purely free radical polymerization, however, the resulting molecular weight distributions were distinctly bimodal, indicating an additional contribution from the cationic mechanism. On the other hand, the rates of polymerization for rigorously dried samples were 2 to 3 orders of magnitude greater than accepted free-radical values, and the molecular weight distributions were unimodal in nature. The experimental results were compared with theoretical kinetic data and molecular weight distribution data generated from a kinetic scheme taking into consideration polymerization via free-radical, cationic, and radical-cationic species, resulting in the evaluation of a number of quantities of interest. Substitution of determined values for the rate constants and G values results in good agreement between theoretically generated and experimentally determined kinetic data and molecular weight distribution data over the range of experimental conditions studied. (auth)

35924 CHAIN SCISSION DURING THE IRRADIATION OF POLY(VINYL CHLORIDE). Salovey, R.; Gebauer, R. C. (Hooker Chemical Corp., Niagara Falls, N. Y.). J. Polym. Sci., Part A-1; 10: No. 5, 1533-7(May 1972).

Radiation-induced changes in molecular weight and distribution result from simultaneous chain scission and crosslinking during exposure of PVC to ionizing radiation in air. Main-chain scission accompanied by the formation of unsaturated aldehydes is inferred from ultraviolet absorption and concentration of absorbing species in low-molecular-weight components of irradiated PVC. A mechanism for the radiolysis involves the reactions of alkyl radicals formed by C–Cl bond scission. (auth)

35925 FORMATION AND TRANSFORMATION OF RADICALS IN HIGH POLYMERS OF GLUCOSE DURING γ RADIOLYSIS. Gol'din, S. I.; Sharpatyi, V. A.; Markevich, S. V. (Inst. of Physical Organic Chemistry, Minsk. Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 1, 133-61(Nov 1971). (In Russian).

The nature of radicals formed during radiolysis of dextrin, polyglucin, and glucose at 77 and 300°K was studied by means of EPR. The majority of radicals formed from the three types of samples were identical in nature, and a few differences were ascribed to structural features of the polymers as contrasted to glucose, and to the presence of water of crystallization, which prior vacuum drying had failed to remove. The source of the radiation was not specified. (K.S.W.)

35926 LUMINESCENCE TIME FOR CsI(Tl) DURING GAMMA IRRADIATION. Belyavskii, Ya. D.; Gulakov, I. R.; Pertsev, A. N. Zh. Prikl. Spektrosk.; 15: No. 4, 658-62(Oct 1971). (In Russian).

A triplet model of the excited state of the luminescence center of CsI(Tl), which had been proposed for a study of the temperature–time relation of luminescence during betatron excitation, was employed for calculating the luminescence time for gamma excitation at room temperature. Agreement with experimental data was obtained for nonequilibrium population of levels of the triplet. The luminescence time as a function of the integration time amounted to 0.87 to 1.5 μsec. (tr-auth)

35927 CLEAVAGE OF TRITIUM FROM SOLID ADENINE-2-T AND ADENINE-8-T INDUCED BY ^{60}Co-γ-RADIATION. Merwitz, O. (Kernforschungsanlage, Juelich, Ger.). Biophysik; 8: No. 3, 245-53(1972). (In German).

In continuation of previous studies specifying the dose-effect curves for radioinduced tritium cleavage from specifically labeled thymines, tritium cleavage from adenine-2-T and adenine-8-T was investigated. The graphically determined threshold doses for cleavage of tritium are in the range of 3×10^5 rad for adenine-8-T and in the range of 2×10^7 rad for adenine-2-T. Comparison of the dose-effect curves proves that, in contrast to the thymines, tritium cleavage from specifically labeled adenines requires high doses. The divergent radioresistances of thymine and adenine are discussed. (auth)

35928 RADIATION CHEMICAL OXIDATION OF ETHYLBENZENE IN THE PRESENCE OF ETHYLBENZENE HYDROPEROXIDE. Kroo, Erik; Danoczy, Richardne; Gal, Dezso. Magy. Kem. Foly.; 78: No. 2-3, 104-8(Feb-Mar 1972). (In Hungarian).

Ethylbenzene was irradiated in the presence of oxygen and ethylbenzene hydroperoxide in the temperature range 20 to 90°C. The accumulation of hydroperoxide was temperature- and dose rate-dependent below 50°C. Above this temperature the process took place as a fast chain reaction. Ketone and alcohol were not detected among the products. A hydroperoxide dimer and its excitation are assumed in order to explain the experimental results. (auth)

35929 ESR SPECTRUM OF BROMOPYRIDINES IRRADIATED WITH ULTRAVIOLET LIGHT. CONFIRMATION OF PYRIDYL RADICAL FORMATION IN IRRADIATED PYRIDINE AND THEIR FORMATION MECHANISM. Tsuji, Kozo; Seiki, Toshifumi (Sumitomo Chemical Co., Ltd., Osaka). Bull. Chem. Soc. Jap.; 45: No. 3, 923-4(Mar 1972).

Photolytic studies on 2- and 3-bromopyridines were performed in order to confirm the assignment of a three-line ESR spectrum to 2-pyridyl radicals in previous studies with electron beams and γ rays at −196°C. The formation mechanism was also studied. (J.G.B.)

35930 ABSORPTION SPECTRA OF DIANTHRACENE ANION RADICAL AND ANTHRACENE DIMER ANION. Shida, Tadamasa; Iwata, Suehiro (Inst. of Physical and Chemical Research, Wako, Japan). J. Chem. Phys.; 56: No. 6, 2858-64(15 Mar 1972).

Dianthracene in γ-irradiated rigid ethereal solutions at 77°K reacts with mobile electrons produced by ionization to give a pair of anthracene molecule and anion, which interact weakly to constitute a dimer anion. The dimer anion exhibits spectral features of (i) an extra intermolecular charge resonance band in the near infrared region, (ii) hypochromism in comparison to the free anthracene molecule and anion. The observed spectrum of the dimer can be well accounted for by molecular orbital calculations with the assumption of a sandwich structure for the dimer. In contrast to the mobile electron the matrix-trapped electron that has less kinetic energy reacts with dianthracene only to give dianthracene anion radicals, which show doublet charge resonance bands in the near-infrared region. The anion is unstable both thermally and optically, and splits to an anthracene molecule and an anion via the dimer anion. (auth)

35931 PROCESS FOR CURING SYNTHETIC RESIN MIXTURES WITH IONISING RADIATION. (to Ciba-Geigy AG). British Patent 1,275,817. 24 May 1972. Priority date 17 Mar 1969, Switzerland.

A process for preparing cured products, especially in the form of thin layers or coatings, is described that comprises exposing to ionizing radiation a curable synthetic resin mixture comprising at least one prepolymer or telomer of a dialkyl phthalate or di(methallyl) phthalate and at least one copolymerizable olefinically unsaturated monomer. (D.H.M.)

35932 INFLUENCE OF γ-RADIATION ON THE STRUCTURE AND INFRARED SPECTRUM OF POLY(VINYL ALCOHOL). Korodenko, G. D.; Zakharchuk, A. V.; Karimov, S. N. (Tadzhik State Univ., Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR; 14: No. 10, 37-40(1971). (In Russian).

Samples of poly(vinyl alcohol) (PVA) of two types were irradiated with gamma rays (source not specified): oriented PVA-2×10^5 R, and nonoriented PVA-1×10^8 R. Differential ir spectra of these irradiated samples were recorded, showing a break in the macromolecule and cleavage of OH groups. The latter action resulted in unsaturation, located principally in the amorphous regions, and gave rise to new absorption bands clearly depicted in the differential spectra. (K.S.W.)

35933 EFFECT OF ORIENTED POLYMERIZATION ON THE VALUE OF TOTAL ACTIVATION ENERGY OF THE PROCESS OF RADIATION POLYMERIZATION IN THE GAS PHASE ON POLYMERIC SUBSTRATES. Vlasov, A. V.; Malakhova, L. I.; Mikhailov, N. V.; Tsetlin, B. L. (Inst. of Elemental-Organic Compounds, Moscow. All-Union Research Inst. of Artificial Fibers, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 5, 1143-4 (11 Dec 1971). (In Russian).

The total activation energies of radiation polymerization in the gas phase were determined for acrylonitrile, acrylic acid, and styrene on supports of various kinds. The rates of polymer branching were measured between 30 and 80°C, and their dependence on temperature conformed to the Arrhenius equation. The data obtained supported the hypothesis concerning the effect of oriented polymerization on the total activation energy. (K.S.W.)

35934 PULSE RADIOLYSIS OF AQUEOUS SOLUTIONS SATURATED WITH NITROUS OXIDE AND HYDROGEN. Frunze, T. A.; Shubin, V. N. (Inst. of Electrochemistry, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 5, 1151-3(11 Dec 1971). (In Russian).

Aqueous solutions were saturated with a H_2-N_2O mixture and subjected to a periodic source of radiation (series accelerator, with 2.5-msec pulses of electrons, and a maximum dose of 5,000 R). The optical absorption of the solutions was determined between 240 and 525 mμ, and two bands at about 240 and 430 mμ were found. The rate of change of optical density at 430 mμ with respect to time of exposure was determined. The data are discussed in the light of a mechanism proposed. (K.S.W.)

35935 INFLUENCE OF THE AGGREGATE STATE OF RUBBER ON THE RATE OF RADIATION TRANSFORMATION. Bol'shakova, S. I.; Degteva, T. G.; Kuz'minskii, A. S. (Research Inst. of the Rubber Industry, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 5, 1164-6(11 Dec 1971). (In Russian).

An anomalous temperature dependence of radiation crosslinking of rubbers is fairly characteristic of this process. The change in concentration of intermolecular bonds was investigated during irradiation of the copolymer of butadiene with acrylonitrile, and of cis-polybutadiene. Rubbers containing phenyl-β-naphthylamine were independent of the presence of peroxide groups in the rubber. Thus, structure defects (peroxide groups) affect the character of radiolytic conversion of rubber, which in turn relates to the anomalous dependence of the rate of crosslinking on the temperature of irradiation. (K.S.W.)

35936 SOME PROBLEMS OF THE KINETICS OF THE EMULSION POST-POLYMERIZATION OF STYRENE. Polikarpov, V. V.; Lukhovitskii, V. I.; Karpov, V. L. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 14: No. 5, 1116-21(May 1972). (In Russian).

The dependence of the emulsion post-polymerization rate (v) of styrene on the initial conversion (conversion under irradiation), the potassium laurate concentration (c), and the dose rate (I) were studied. The post-polymerization rate increased with increasing initial conversion, dose rate ($v \sim I^{0.25}$), and emulsifier concentration ($v \sim c^{0.6}$ for the initial conversion 12 to 15% and $v \sim c^{1.1}$ for 8 to 9.5%). The decrease of the polymerization rate down to a certain limit after interruption of irradiation was accounted for by the decrease in the number of particles per 1 ml of latex and not by the radical exit into the bulk. This is evidenced by the fact that the post-polymerization per particle is twice as high as the radiation polymerization rate. It is also shown that the post-polymerization cannot be caused by hydrogen peroxide formed during water radiolysis. (auth)

35937 GAMMA-RADIATION IN COLLAGEN SOLUTIONS. INFLUENCE OF SOLUTES ON THE GELATION DOSE. Labout, J. J. M. (Univ. of Utrecht). Int. J. Radiat. Biol.; 21: No. 5, 483-92(May 1972).

Gamma-irradiation of ichthyocol solutions caused extensive intermolecular crosslinking of the collagen molecules, leading to gelation. From the effect of added free radical scavengers on the gelation dose it was concluded that only the hydrogen atom initiates the crosslinking process. The reaction constant K ($H\cdot$ + collagen) was found to be about 10^{10} M^{-1} s^{-1}. Four or less hydrogen atoms were needed to establish an intermolecular crosslink. It is suggested that the hydrogen atoms can reduce some special sites on the macromolecule to groups bearing an aldehyde function. Such groups are also involved in natural crosslinks in matured collagen. (auth)

35938 ELECTRON SPIN RESONANCE SPECTRA OF ALIPHATIC FLUOROALKYL RADICALS IN POLYCRYSTALLINE STATE. II. GAMMA RADIOLYSIS OF TRIFLUOROACETIC ACID. Mach, K. (Inst. of Physical Chemistry, Prague). Collect. Czech. Chem. Commun.; 37: No. 3, 923-34(Mar 1972).

An aqueous solution of CF_3COOH and its sodium salt, irradiated by γ-radiation at 77°K, give ESR spectra of the $\dot{C}F_3$ radical the edge peaks of which are separated by 756 G. This value corresponds to the maximum principal value of the tensor of the F_α-interaction $A_{max}^{F\alpha} = 253$ G. The pure acid CF_3COOH, after γ-irradiation at 77°K, gives a somewhat narrower spectrum (maximum 743 G). This indicates that the $\dot{C}F_3$ radical formed by γ irradiation has valence angles that differ from those of the same radical obtained by a long stay at 77°K or by heating the irradiated sample of the acid to -160°C, which has the maximum width of the spectrum of 772 G. In both cases at the edges of spectra there are groups of bands of the width of 44 G indicating that the radical is fixed in several magnetically nonequivalent positions in the crystal lattice. The narrower spectrum cannot be interpreted as the spectrum of the radical-anion $CF_3\dot{C}OOH^-$ because the F_β atoms cannot achieve the value (the mean value) of $A_{max}^{F\beta} = 248$ to 218 G at the same time. In both the acid and its sodium salt the $\dot{C}F_3$ radicals vanish by heating giving rise to the radicals $\dot{C}F_2COOH$ and $\dot{C}F_2COO^-$, respectively. In the aqueous solution of the acid they vanish completely without any trace. The temperature dependence of the F_α splitting of the latter radicals depends on the strength of the crystal lattice. The mechanism of the radiolysis of CF_3COOH is discussed assuming the abundance of the $\dot{C}F_3$ and $\dot{C}F_2COOH$ radicals that are supposed to be the products of the decomposition of the ionized species. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 35909 and 37733.

35939 RADIOCHROMATOGRAPHY OF TRITIUM-LABELED DIMERIC HYDROCARBONS. Filatov, E. S.; Makarov, V. A.; Kukin, P. P. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 1, 59-63(Jan-Feb 1972). (In Russian).

Retention times for certain bicyclic compounds were obtained by the use of the column with polyethylene glycoladipinate operating at various temperatures (100 to 180°C). The gas flow proportional counter placed in the outlet of the column was applied for tritium radioactivity assay. The successful identification of certain bicyclic compounds originating from radiolysis, hot tritium atom reactions, and thermal radical–radical reactions was achieved. (auth)

35940 METHOD FOR PREPARATION OF SELENOUREA-^{75}Se. Kronrad, L.; Hladik, V. (Nuclear Research Inst., Prague). Int. J. Appl. Radiat. Isotop.; 23: No. 5, 237(May 1972).

Disadvantages of the common methods for the preparation of this compound, which is of interest in biochemistry, are described. The recommended new procedure basically involves reaction of ammonium selenide-^{75}Se with cyanamide to produce the selenourea-^{75}Se. Details are given of the apparatus and procedure employed. The compound is obtained in the form of needle-like crystals, and the yield of ^{75}Se activity in the form of selenourea is 75 to 80%. (UK)

35941 ^{113m}In ALBUMIN AGGREGATES FOR LUNG SCANNING. Harding, L. K.; Keeling, D. H. (Middlesex Hospital Medical School, London). Int. J. Appl. Radiat. Isotop.; 23: No. 5, 253 (May 1971).

The labeling of albumin with ^{113m}In in the presence of zirconium compounds to form a radiopharmaceutical is discussed. Aqueous and physiological saline solutions of zirconium sulphate hydrolyse when heat sterilized, and this impairs labeling efficiency. After bacterial ultra-filtration a similar change occurs on standing, and although a variety of organic acids prevents hydrolysis, these also impair labeling efficiency. Zirconium chloride is not suitable due to formation of the insoluble oxychloride in water. Details are given of the preparation of a suitable presterilized solution that stabilizes the zirconium sulphate and allows a labeling efficiency >90% even after a shelf life of 5 months. This solution comprises trisodium citrate, dextrose, citric acid, and pyrogen-free water. (UK)

Hot-Atom Chemistry

35942 (FRNC-TH-178) CHEMICAL EFFECTS OF THE ^{127}I(n,γ)^{128}I REACTION IN IODINE AND BENZENE MIXTURES. Uenak, Turan (Strasbourg Univ. (France)). 1971. 71p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Recent data on the ^{127}I(n,γ)^{128}I reaction are presented. The characteristics (recoil energy, state of ionization) of the hot ^{128}I atom are examined. Different models for hot reactions are presented. Samples containing the $I_2 + C_6H_6$ mixture in well-defined proportions were irradiated in a nuclear reactor using a thermal neutron flux of 10^{12} n · cm^{-2} · s^{-1} and a dose rate of 3.5×10^4 rad · min^{-1}. The chemical effects of the ^{127}I(n,γ)^{128}I reaction in benzene were studied in the solid, liquid, and gas phases. The organic forms of ^{128}I produced (CH_3I, C_2H_3I, $C_2H_2I_2$, C_6H_5I, $C_6H_4I_2$, and $C_6H_5-C_6H_4I$) were analyzed qualitatively and quantitatively by gas phase chromatography. The variations in the individual yields of ^{128}I compounds and the total organic yield of ^{128}I were studied as a function of the molar fraction of I in the mixture. The total organic yield of ^{128}I was determined by subtracting the ^{131}I yield of radiolytic mechanisms from the experimental yield. In the liquid phase, the total yield was 12% for I fractions less than 5×10^{-3}, and C_6H_5I represents 88% of the total organic activity. The liquid/solid phase transition doubled the organic yield for molar I_2 fractions less than 4×10^{-4}. In the gas phase, the organic yield was 60 times less than in the liquid phase. (France)

35943 IMPROVED METHOD FOR THE ION-EXCHANGE CHROMATOGRAPHIC SEPARATION OF ^{32}P-LABELLED OXO-ANIONS OF PHOSPHORUS PRODUCED IN NEUTRON-IRRADIATED ORTHOPHOSPHATES. Tominaga, Mamoru; Nakamura, Terumasa; Ohashi, Shigeru (Kyushu Univ., Fukuoka). J. Inorg. Nucl. Chem.; 34: No. 4, 1409-15(Apr 1972).

The separation of ^{32}P-labelled oxo-anions of phosphorus produced in neutron-irradiated orthophosphates by means of ion-exchange chromatography was investigated. The fifteen kinds of oxo-anions of phosphorus were separated by using Dowex 1-×8 resin and sodium chloride solution as eluent in the order of ^{1}P-, $^5P_1$-, ^{3}P-, ^{4}P-^{4}P-, ^{2}P-^{4}P-, ^{3}P-O-^{3}P-, ^{3}P-O-^{5}P-, $^5P_2$-, ^{4}P-^{3}P-^{4}P-, ^{3}P-O-^{4}P-^{4}P-, ^{5}P-O-^{4}P-^{4}P-, $^5P_3$-, $^5P_4$-, $^5P_5$- and $^5P_{3m}$-anions. This method was applied to hot-atom chemistry of phosphorus and a complex mixture of ^{32}P recoil species in neutron-irradiated potassium dihydrogen orthophosphate was successfully separated. (auth)

35944 RADIATION-INDUCED TRANSFER AND ANNEALING IN TRISACETYLACETONATO CHROMIUM(III). Gainar, I. (Inst. for Atomic Physics, Bucharest). Radiochem. Radioanal. Lett.; 10: No. 2, 113-17(14 May 1972).

A comparative study of radiation and thermally induced annealing and transfer is reported. A difference in the behavior of the radiation and thermally induced processes is evidenced. Two mechanisms are proposed to account for this difference. (auth)

35945 CHEMICAL EFFECTS OF NUCLEAR REACTIONS DUE TO THERMAL NEUTRONS. PART 1. RECOIL OF THE NUCLEUS. Mahieu, B.; Apers, D. J.; Capron, P. C. (Laboratoire de Chimie Nucleaire, Heverlee, Belg.). Rev. Quest. Sci.; 143: No. 2, 223-35(1972). (In French).

The de-excitation of the atom that has captured a neutron and its behavior during recoil were analyzed in order to eventually determine the causes of the retention. (tr-auth)

Properties of Radioactive Materials

Refer also to abstracts 35854, 35877, 35886, 35895, 36480, 36499, and 37483.

35946 (CEA-Bib-193) SOLUTION CHEMISTRY OF TRANSURANIDES. Tostain, Jacqueline (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1972. 147p. (In French). Dep. NTIS (U. S. Sales Only).

Papers published from 1950 to 1970 inclusive on the solution chemistry of transuranium elements are covered. Abstracts and reference numbers to Nuclear Science Abstracts and/or Chemical Abstracts are given. (460 references). (M.C.G.).

35947 THIOCYANATE AND CHLORIDE COMPLEXES OF SOME TRIVALENT ACTINIDES. Harmon, Harry Douglas. Knoxville, Tenn.; Univ. of Tennessee (1971). 160p. University Microfilms Order No. 72-5445.

Thesis.

The thiocyanate and chloride complexes of some trivalent actinides in solutions of both constant and variable ionic strength were investigated by solvent extraction, spectrophotometric, and anion exchange techniques. When possible, curve-fitting procedures were applied to calculate the various complex stability constants from the experimental data. A solvent extraction technique, using bis(2-ethylhexyl)phosphoric acid (HDEHP) as the extractant, was employed to examine the formation of Am(III), Cm(III), Bk(III), Cf(III), and Es(III) thiocyanate complexes in $NaSCN-NaClO_4$ media at ionic strength I = 1.0 and pH = 2.00. Mathematical analyses of the data led to the conclusion that the mono-, di-, and trithiocyanate species exist in the thiocyanate concentration range of 0.01 to 1.0M. Values of the overall stability constants β_1, β_2, and β_3 were calculated. As the atomic number of the actinides increased, the β_1 values exhibited a gradual increase, which is consistent with the expected effect on complex stability due to the actinide contraction. The β_2 values decreased rapidly across the series from americium to einsteinium with a concomitant increase in β_3. In addition, there was evidence of the tetrad effect in the β_3 values, and this led to the tentative conclusion that the $Act(SCN)_3$ (where Act = Am, Cm, Bk, Cf, and Es) complexes are the inner-sphere type. The thermodynamic parameters of the Am(III) thiocyanate complexes were determined by the temperature-dependence method. The enthalpy and entropy changes for the formation of $Am(SCN)^{2+}$ were shown to be consistent with outer-sphere complex formation. The negative enthalpy and entropy values for $Am(SCN)_3$ did not unambiguously support the evidence that the actinide(III) trithiocyanate complexes are of the inner sphere type. The results of a spectrophotometric study of Am(III) thiocyanate complex formation in $NaSCN-NaClO_4$ solutions at I = 1.0 and pH = 2.0 enabled calculation of the stability constants for $Am(SCN)^{2+}$ and $Am(SCN)_2^+$. The small spectral changes associated with the formation of $Am(SCN)_2^+$ were in agreement with the thermodynamic evidence for outer-sphere complex formation. The larger spectral changes observed above 0.1M SCN^- suggested that $Am(SCN)_2^+$ and any additional complexes are of the inner-sphere type. Spectrophotometric studies of Am(III) in KSCN solutions of variable ionic strength suggested that Am(III) is strongly complexed, with qualitative evidence for anionic complexes in 5 to 10M KSCN. The "effective stability constant" approach was applied to the spectrophotometric data at low KSCN concentration. Qualitative interpretation of Am(III) solvent extraction and anion-exchange resin sorption from concentrated KSCN solutions did not support the spectral evidence for significant concentrations of anionic thiocyanate complexes. However, perturbing factors, such as variable HSCN extraction, may have prevented these systems from reflecting the actual aqueous complex formation; so the spectral evidence was considered more meaningful. The chloride complexes of Bk(III) and Es(III) were studied by a HDEHP extraction technique in $NaCl-NaClO_4$ media at I = 1.0 and pH = 2.00. The stability constant of the $ActCl^{2+}$ species [where Act = Bk(III) and Es(III)] was calculated from the extraction data. There was no evidence for the existence of additional complexes. The extraction of Am(III) by tri-n-octylphosphine oxide (TOPO), tri-n-octylamine (TOA), and methyl trialkyl(C_8 to C_{10})-ammonium chloride (Adogen 464) from HCl and slightly acidic LiCl solutions was investigated in attempts to find a suitable system for studying actinide(III) complexes in concentrated chloride solutions. The varied extraction behavior in these systems indicated that the organic phase composition, and not the aqueous chloride complex formation, was the controlling factor on the Am(III) extraction. Detailed studies on the TOPO-LiCl and Adogen 464-

LiCl systems found wide variations in lithium and water extraction as a function of aqueous LiCl molarity. With Eu(III) as a stand-in for Am(III), linear extraction isotherms showed that the metal ion species exists with the same degree of association in both phases. Also, reagent dependence studies indicated the extraction of primarily $AmCl_3 \cdot TOPO$ and $AmCl_3 \cdot 3TOPO$ from 1 and 5M LiCl, respectively, and R_4NAmCl_4 (where R_4N^+ is the quaternary ammonium cation of Adogen 464) from both 1 and 5M LiCl. It was concluded that the TOPO—LiCl and Adogen 464—LiCl systems would be unsuitable for these aqueous chloride complex studies. (Diss. Abstr. Int., B)

35948 CRYSTAL STRUCTURE OF $UF_4.2.5\ H_2O$. Zadneprovskii, G. M.; Borisov, S. V. (Far-Eastern Scientific Center, Vladivostok, USSR. Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Strukt. Khim.; 12: No. 5, 831-9 (Sep-Oct 1971). (In Russian).

The crystal structure of $UF_4 \cdot 2.5\ H_2O$ was studied with a diffractometer and nuclear magnetic resonance. The position of the atoms U, F, and O in the rhombic cell with a = 12.7563, b = 11.140, and c = 7.060 Å, and Z = 8 were made more precise to R = 0.150. U_2 is surrounded by nine F at a distance of 2.39 Å, and U_1 by five F (2.29 Å) and four O (2.63 to 2.84 Å). The directions of the H bonds are discussed. The data agree with NMR and ir data. (K.S.W.)

35949 REVERSIBLE DISPROPORTIONATION OF UO_2(V) IN MOLTEN CHLORIDES. INFLUENCE OF TEMPERATURE AND COMPOSITION OF THE SOLVENT. Landresse, G.; Duyckaerts, G. (Univ., Liege). Anal. Chim. Acta; 59: No. 2, 261-72(Apr 1972). (In French).

The influence of temperature (400 to 500°C), and of the solvent composition on UO_2(V) disproportionation was studied by visible and near infrared absorption spectrophotometry in the following molten chlorides: LiCl—KCl eutectic, LiCl—KCl (70 to 30 mol %), LiCl—CsCl (55 to 45 mol %), and NaCl—KCl—$MgCl_2$ ternary eutectic. An increase in temperature or charge density of the cations of the solvent or a decrease in the pressure of HCl favor the stability of UO_2(V). In the case of molten NaCl—KCl—$MgCl_2$ eutectic, the displacement of the disproportionation equilibrium seems to be due to the complexation of UO_2(V) by chloride ions to form a species more stable than in alkali chlorides. (auth)

35950 INVESTIGATION OF THE COMPLEX FORMATION OF TRIVALENT PLUTONIUM, AMERICIUM, AND CURIUM IN PHOSPHATE SOLUTIONS. Moskvin, A. I. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 688-93(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 668-74(Sep-Oct 1971).

The orthophosphate $PuPO_4 \cdot xH_2O$ was identified in solid form, and its solubility in aqueous solutions was determined at various pH values. The value of the solubility product of $PuPO_4 \cdot xH_2O$, equal to 4.3×10^{-25} (at $\mu = 0.5$), was found. The composition and stability constants of complexes of the type of $M(H_2PO_4)_j^{3-j}$ (j = 1, 2 ... 4) and $Cm(PO_4)_j^{3-3j}$ (j = 1 and 2) were determined by the ion-exchange method. (auth)

35951 COMPLEX FORMATION OF NEPTUNIUM(IV, V, VI) IN CARBONATE SOLUTIONS. Moskvin, A. I. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 694-9(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 674-81(Sep-Oct 1971).

The solubility of neptunium(IV, V, VI) hydroxides, ammonium neptunoyl carbonate, and ammonium neptunoyl tricarbonate in aqueous solutions of $(NH_4)_2CO_3$ of various concentrations was determined. The composition and dissociation constants of the carbonate complexes of neptunium(IV, V, VI) formed under the conditions investigated were determined. The absorption spectra of carbonate solutions of neptunium(IV, V, VI) obtained in this case were measured. (auth)

35952 HYDROLYTIC BEHAVIOR OF NEPTUNIUM(IV, V, VI). Moskvin, A. I. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 700-5(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 681-8(Sep-Oct 1971).

The solubility of neptunium(IV, V, VI) hydroxides was determined in a broad range of pH values of the aqueous solutions. The absorption spectra of saturated solutions obtained in this case, containing Np(IV), Np(V), and Np(VI), were measured, and indicate the formation of various hydrolyzed forms of neptunium in the corresponding oxidation state. The solubility products of neptunium(IV, V, VI) hydroxides and the composition and dissociation constants of the hydroxy complexes of neptunium(IV, V, VI) formed under the conditions investigated were determined from the experimental data obtained. (auth)

35953 INTERACTION OF MALONATE COMPLEXES OF URANYL WITH HYDROGEN PEROXIDE. II. INVESTIGATION OF EQUILIBRIA IN THE SYSTEM UO_2^{2+}—H_2O_2—$C_3H_2O_4^{2-}$—H_2O. Gurevich, A. M.; Polozhenskaya, L. P.; Osicheva, N. P.; Solntseva, L. F. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 706-9(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 688-92(Sep-Oct 1971).

The formation of the peroxomalonate complex of uranyl was studied by the methods of light absorption and pH measurement ($2[UO_2(Mal)_2]^{2-} + 2H_2O_2 \rightleftharpoons [(UO_2)_2(OO)_2(Mal)_2]^{4-} + 4H^+ + 2Mal^{2-}$) and its stability constant was estimated. A scheme corresponding to the mechanism of the interaction of malonate complexes of uranyl with H_2O_2 is proposed. (auth)

35954 STUDY OF COMPLEX FORMATION BY THE EXTRACTION METHOD. I. COMPLEX FORMATION OF AMERICIUM, CURIUM, CALIFORNIUM, AND PROMETHIUM WITH o-HYDROXYPHENYLIMINODIACETIC ACID. Ermakov, V. A.; Vorob'eva, V. V.; Zaitsev, A. A.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 710-13(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 692-6(Sep-Oct 1971).

The extraction constants of americium, ($\log K_{ex} = -7.92$), curium ($\log K_{ex} = -7.92$), californium ($\log K_{ex} = -6.89$), and promethium ($\log K_{ex} = -8.00$) by thenoyltrifluoroacetone in benzene were determined at an ionic strength of 0.1M and t = (25 ± 0.1)°C. It was established that in the pH region investigated OPIDA (O-hydroxyphenyliminodiacetic acid) forms complex ions with the composition $[MeA]^+$ and $[MeA_2]^-$ with americium, curium, californium, and promethium. The stability constants of the complex ions of americium ($\beta_1 = 6.31 \pm 10^6$, $\beta_2 = 7.25 \times 10^{11}$), curium ($\beta_1 = 6.31 \times 10^6$, $\beta_2 = 8.71 \times 10^{11}$), californium ($\beta_1 = 2.50 \times 10^7$, $\beta_2 = 1.90 \times 10^{12}$), and promethium ($\beta_1 = 5.01 \times 10^6$, $\beta_2 = 3.63 \times 10^{11}$) were determined. (auth)

35955 KINETICS OF THE RADIATION CHEMICAL REDUCTION OF AMERICIUM(VI) AND (V) IN AQUEOUS SOLUTIONS IN THE PRESENCE OF PEROXYDISULFATE IONS. Ermakov, V. A.; Timofeev, G. A.; Rykov, A. G.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 727-33(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 709-16(Sep-Oct 1971).

The rate of reduction of americium(VI) and (V) depends on the α radiation dose rate and the concentration of $S_2O_8^{2-}$ ions. The rate constants of formation of ·H and ·OH radicals were determined. It was shown that r_H and r_{OH} in the solutions investigated do not depend on the dose rate in a broad range of dose rates. The ratio of the rate constants of the reactions: $HO_2^{\cdot} + S_2O_8^{2-} \xrightarrow{K_3} HSO_4^- + SO_4^- + O_2$ and $HO_2^{\cdot} + Am(V) \xrightarrow{K_{10}} Am(III) + H^+ + O_2$ was dedetermined. Stationary concentrations of $HO_2^{\cdot}$ and ·OH radicals are linear functions of the dose rate. A radical mechanism was proposed for the reduction of americium(VI) and (V), satisfactorily describing the experimental data. (auth)

35956 USE OF COMPOUNDS OF THE NOBLE GASES FOR THE PRODUCTION OF HEPTAVALENT NEPTUNIUM. Klimov, V. D.; Prusakov, V. N.; Sokolov, V. B. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 742-5(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 725-8(Sep-Oct 1971).

It was established that xenon difluoride readily oxidizes hexavalent neptunium in solutions with KOH concentrations ≲5M at temperatures of 20°C and below. Under analogous conditions XeF_2 also rapidly oxidizes pentavalent neptunium to neptunium(VII). It was shown that xenon trioxide oxidizes neptunium(VI) at a measurable rate in 10 to 11M KOH. The oxidation process is complicated by side reactions. (auth)

35957 OXIDATION OF PLUTONIUM(VI) TO THE HEPTAVALENT STATE BY POTASSIUM PERMANGANATE AND SILVER OXIDE. Peretrukhin, V. F.; Krot, N. N.; Gel'man, A. D. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 794-5(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 772-3(Sep-Oct 1971).

The reactions of plutonium(VI) with permanganate ions and silver oxide were studied in aqueous solutions with sodium hydroxide concentrations from 1 to 12M. (M.C.G.)

35958 INVESTIGATION OF RUBIDIUM URANATES. Kovba, L. M.; Trunova, V. I. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 796-7(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 773-4(Sep-Oct 1971).

It was established that in the system Rb_2UO_4—U_3O_8—O_2 only Rb_2UO_4, $Rb_2U_2O_7$, $Rb_2U_4O_{13}$, and $Rb_2U_7O_{22}$ are formed. Structures of the compounds were studied. (M.C.G.)

35959 REACTIONS AND COMPARATIVE REACTIVITY OF URANIUM HEXAFLUORIDE. Wilson, P. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Rev. Pure Appl. Chem.; 22: No. 1, 1-12(Mar 1972).

Some of the reactions and properties of UF_6 are described and its reactivity is compared with that of other related fluorides. Most of the descriptive chemistry of UF_6 that is known is presented. (D.H.M.)

35960 KINETICS OF OXIDATION OF TETRAVALENT ^{233}Pa IN AQUEOUS MEDIA BY CHLORINE, BROMINE, AND IODINE. Carlier, R. (Institut du Radium, Paris); Genet, M. Radiochem. Radioanal. Lett.; 10: No. 2, 91-7(14 May 1972). (In French).

The oxidation of ^{233}Pa(IV) by halogen in aqueous solutions (pH = 5.5) was studied. Experimental rate constants and the order of reaction with respect to halogen were determined. (auth)

35961 POLAROGRAPHIC EVIDENCE FOR THE DIVALENT OXIDATION STATE OF CALIFORNIUM. Friedman, H. A.; Stokely, J. R.; Baybarz, R. D. (Oak Ridge National Lab., Tenn.). Inorg. Nucl. Chem. Lett.; 8: No. 5, 433-41(May 1972).

It is stated that no conclusive evidence for the existence of the divalent oxidation states of Cf, Es, and Fm has been reported. On the other hand, there is considerable indirect experimental evidence, and also theoretical prediction, that a divalent oxidation state of Cf can exist. The experimental evidence comes from radiopolarographic experiments in aqueous media, amalgamation studies, and distribution studies of Cf between molten salts and liquid Bi. The theoretical predictions are based on spectroscopic studies. Results obtained in a study of the polarographic properties of the actinides in nonaqueous solvents showed definite evidence of Cf(II). Values were obtained for the half-wave potentials of the Cf(III)/Cf(II) and Cf(II)/Cf(0) couples in acetonitrile, indicating the relative stability of the divalent oxidation state. Details are given of the apparatus and procedure used, and results are discussed. (UK)

35962 NEW REACTIONS FOR THE ACETYLACETONATO-METAL COMPLEXES. Issa, I. M ; Aly, M. M.; Khalil, L. H. (Assuit Univ., Egypt). Inorg. Nucl. Chem. Lett.; 8: No. 5, 505-11(May 1972).

Metal–metal exchange reactions in this type of complex are discussed. If an ethanol solution of the chlorides of Cu(II), Mn(II), Co(II), Ni(II), UO_2(II), Fe(III), Cr(III), or Al(III) is mixed with $(acac)_2$ Mg(II) · $2H_2O$ in the same solvent, their acetylacetonato-metal complexes are precipitated. These metal exchange reactions are instantaneous and quantitative. Similar reactions occurred with the Zn(II) complex instead of the Mg(II) complex. The reactions also occurred by boiling ethanol solutions of acetylacetone with Zn dust or Mg turnings in the presence of the metal chloride. Mechanisms are discussed. The formation of the complexes by metal exchange reactions with the Zn or Mg complexes is ascribed to the higher values of their stability constants compared with the Mg(II) or Zn(II) complexes. (UK)

35963 EQUILIBRIA IN SOLUTIONS AND ANION EXCHANGE OF URANIUM(VI) COMPLEXES. III. THE COMPOSITION OF URANIUM(VI) COMPLEXES SORBED ON AN ANION EXCHANGE RESIN FROM SULPHATE SOLUTIONS. Majchrzak, Kazimierz (Instytutu Badan Jadrowych, Warsaw). Nukleonika; 16: No. 7-8, 325-36(1971). (In Polish).

The composition of uranium(VI) complexes sorbed on an anion exchange resin from sulfate solutions was investigated. The complexes were identified from their absorption spectra (400 to 500 nm) and by calculating their composition from the amounts of the sorbed uranium and sulfates. It was found that at low uranium concentrations (<10 mmol/l.) the two complexes $[UO_2(SO_4)_2]^{2-}$ and $[UO_2(SO_4)_3]^{4-}$ are sorbed. At higher uranium concentrations, when excess amounts of sulfates are present, the same complexes are sorbed, but at the deficiency of sulfates ($C_{SO4} \rightarrow C_U$) the sorption of $[UO_2\ SO_{4\ 2}]^{2-}$ prevails. (auth)

35964 ROLE OF MIXED EMULSIFIERS IN EMULSION STABILITY. Sastry, T. G.; Srivastava, S. N. (Agra Coll., India). Z. Phys. Chem. (Leipzig); 249: No. 1-2, 101-15(1972).

Many biological substances were tried before as emulsifiers, and to some extent mixed emulsifiers. But the applicability of the D.L.V.O. (Derjaguin, Landau, Verwey, and Overbeek) theory was not previously tested for emulsion droplets with mixed emulsifiers. Studies are undertaken to test the validity of D.L.V.O. theory as applied to lyophobic colloids with a mixture of equimolecular proportion of lecithin and cholesterol as emulsifier in an oil-in-water system, with petroleum ether as the oil phase. The globule size (0.9-μdia) is determined from size frequency analysis. The flocculation studies were carried out with different electrolytes, viz., NaCl, KCl, $BaCl_2$, $Pb(NO_3)_2$, $UO_2(NO_3)_2$, $La(NO_3)_3$, $AlCl_3$, and $Th(NO_3)_4$, by means of hemocytometry, and the rate constants for flocculation and coalescence and also the degree of aggregation (D%) were calculated. The potentials on the globule surface with the same concentrations of the various electrolytes used for flocculation studies were estimated by microelectrophoresis and from the values of the interaction energies; the theoretical value of degree of aggregation was obtained by using different assumed values of van der Waals constants. On comparing the observed values of D%, the effective van der Waals constant of the system was deduced. A few preliminary experiments on the interaction of proteins with the system at different pH's and ionic strengths were also studied. (auth)

35965 AMERICIUM TRITELLURIDE AND DITELLURIDE. Damien, D. (CEN Fontenay-aux-Roses, France). Inorg. Nucl. Chem. Lett.; 8: No. 5, 501-4(May 1972).

The preparation and crystal structure of $AmTe_3$ and $AmTe_2$ are described. $AmTe_3$ was prepared in a sealed pyrex tube by vapor-phase reaction of excess Te with ^{241}Am hydride at 350°C for 120 hr; and $AmTe_2$ was formed by thermal dissociation of $AmTe_3$ at 400°C under high vacuum. $AmTe_3$ crystallized with parameters $a = 4.339 \pm 0.005$ and $c = 25.57 \pm 0.05$Å, and the data suggest that this compound is isostructural with the corresponding rare earth tritellurides and that the true symmetry is orthorhombic with a = b and spatial group Bmmb. $AmTe_2$ crystallized with parameters $a = 4.366 \pm 0.003$ and $c = 8.969 \pm 0.005$Å, and appears isostructural with the rare earth ditellurites, with the Fe_2As type of structure. The ditelluride is probably a Te-deficient compound $AmTe_{2-x}$, with a rather large homogeneity range between 400 and 600°C. It is probable that $AmTe_3$ is formed by two $AmTe_2$ cells with an intermediate Te layer. (UK)

35966 PARTICULATE COMPLEXES OF ^{64}Cu AND GELATIN, AND THEIR PREPARATION. Gelis, Christian (to Commissariat a l'Energie Atomique). British Patent 1,276,205. 1 Jun 1972. Priority date 28 May 1969, France.

A ^{64}Cu gelatin complex in particulate form was produced with each particle having a diameter greater than 30 μ. An alkaline solution of ^{64}Cu salt and a solution of gelatin in the cold state were mixed, heated, and the complex precipitated by addition of tannin and distilled water. (M.C.G.)

35967 URANYL HYDROLYSIS IN A HYDROTHERMAL REGION. Nikitin, A. A.; Sergeeva, E. I.; Khodakovskii, I. L.; Naumov, G. B. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 3, 297-307(Mar 1972). (In Russian).

As a result of the experimental study in the temperature range from 25 to 200°C values of uranyl hydroxide solubility in water, which substantially differ from those available in the literature, were obtained. This is conditioned by the duration of equilibration. It was established that at temperatures above 50°C dissolution proceeds with the formation of undissociated $UO_2(OH)_2^0$ molecules and at room temperature the presence of more complicated polynuclear molecules is probable. On the basis of the solubility values and of a critical analysis of literary data more precise definitions were obtained for the thermodynamic properties of a number of compounds of hexavalent uranium and its ions in aqueous solution, the uranyl hydrolysis constants, and the product of $UO_2(OH)_{2(k)}$ for temperatures of 25 to 350°C. The significance of the values for the geochemistry of uranium is shown. (auth)

35968 LUMINESCENCE OF URANYL SULFATE SOLUTIONS IN THE PRESENCE OF ELECTROLYTES AND ORGANIC SUBSTANCES. Dobrolyubskaya, T. S. Zh. Prikl. Spektrosk.; 15: No. 4, 642-6(Oct 1971). (In Russian).

The effect of nearly a hundred additives on the luminescent properties of uranyl sulfate solutions was studied. The results of such a study are of interest in the sensitization of rare earth elements, lasers, and the quantitative determination of uranium. Three groups of substances were evident, as characterized by: increased luminescence both at 20 and −190°C; decreased luminescence both at 20 and −190°C; and decreased luminescence at 20°C only. The first group contained hydrophilic groups (SO_4^{2-}, F^-, and PO_4^{3-} ions); the second contained reagents that either reduced U(VI) or formed peroxides; the third group contained many electrolytes and all organic compounds tested. (tr-auth)

35969 OPTICAL ACTIVITY OF URANYL BUTYRATE CRYSTALS. Alikhanova, Z. M.; Burkov, V. I.; Ivanova, I. N.; (and others). Zh. Prikl. Spektrosk.; 15: No. 4, 747-9(Oct 1971). (In Russian).

Isostructural cubic crystals of uranyl butyrates ($M \cdot UO_2(C_3H_7OO)_3$) possess optical activity (rotatory dispersion) only in the crystalline state. Measurements of the dispersion of optical rotation in the region 0.36 to 0.80 μ as evidence of molecular character of optical activity resulting from a drop in the symmetry of the complex ion $[UO_2(C_3H_7COO)_3]^-$ in the crystal are given. (tr-auth)

35970 NUCLEAR MAGNETIC RELAXATION OF ^{31}P IN LIGAND EXCHANGE IN ORGANOPHOSPHORUS SOLUTIONS OF URANYL NITRATE. Vashman, A. A.; Vereshchagina, T. Ya.; Pronin, I. S. Zh. Neorg. Khim.; 17: No. 2, 471-6(Feb 1972). (In Russian).

The temperature–time dependence of the nuclear spin–spin relaxation of ^{31}P was measured, and the lifetime of the ligands was calculated for solvate envelopes of the complexes. Activation parameters in organophosphorus solutions of $UO_2(NO_3)_2$ were determined. A correlation was established between increase in the activation entropy of the complexes and the increase in the extraction capability of the organophosphorus compounds. Effects of water and HNO_3 on the lability of complexes of $UO_2(NO_3)_2$ were noted with the organophosphorus ligands, which were stimulated by water and acid exchanges. (tr-auth)

35971 URANIUM DITELLURIDE. Ellert, G. V.; Slovyanskikh, V. K. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 17: No. 2, 574-5(Feb 1972). (In Russian).

The composition of the uranium tellurides was studied as a function of temperature during a constant pressure of Te. A sample of UTe_2 was converted into UTe_3 at 580°C. Between 585 and 610°C a mixture of UTe_2 and UTe_3 resulted, which was transformed into UTe_2 in the interval 630 to 960°C, and finally into U_3Te_5 in the range 970 to 1,085°C. X ray examination showed that UTe_2 belonged to the rhombic system. (K.S.W.)

35972 RAPID AND COMPLETE METHOD TO REMOVE PLUTONIUM CONTAMINATION FROM ALUMINUM. Wallace, P. L.; Walden, J. C.; Magana, J. W. (Univ. of California, Livermore). J. Electrochem. Soc.; 119: No. 6, 715(Jun 1972).

A process is described for plutonium decontamination of aluminum parts that involves degreasing the part in acetone; dipping it in a heated (90°C) bath consisting of phosphoric acid, nitric acid, acetic acid, sulfuric acid, water, and crystalline nickel nitrate; rinsing the part in water; drying it; and checking it for any residual contamination. Its principal usage has been in decontaminating x-ray spectrographic cell holders. (D.H.M.)

35973 KINETIC STUDY OF REDOX REACTION OF U(IV) WITH FERRICYANIDE IONS. Adamcikova, L.; Treindl, L. (Komensky Univ., Bratislava). Collect. Czech. Chem. Commun.; 37: No. 3, 762-7(Mar 1972).

The kinetics and mechanism of the redox reaction between U(IV) and ferricyanide ions were studied on the basis of the dependence of the limiting diffusion current of ferricyanide on time. The reaction is of first order with respect to the concentration of both ferricyanide and U(IV) ions. From the temperature dependence of the measured rate constant, activation parameters were determined with the use of the Eyring equation at two ionic strength values. From the dependence of the rate constant on concentration of hydrogen ions at different temperatures, the thermodynamic constants of the hydrolytic equilibrium of U^{4+} ions were derived as $\Delta G^0 = 1.92$ kcal mole^{-1}, $\Delta H^0 = (11.8 \pm 0.5)$ kcal mole^{-1} and $\Delta S^0 = (33 \pm 1.3)$ cal K^{-1} mole^{-1} together with activation parameters of the elementary redox reaction $\Delta H^{\neq} = (5.08 \pm 0.6)$ kcal mole^{-1}, $\Delta S^{\neq} = (-32.9 \pm 1.8)$ cal K^{-1} mole^{-1}. A reaction mechanism is proposed and discussed according to which the elementary redox reaction is an interaction of the $HFe(CN)_6^{2-}$ ion with UOH^{3+}. (auth)

35974 KINETICS OF POLAROGRAPHIC REDUCTION OF URANIUM(VI) IN PHOSPHORIC ACID SOLUTIONS. Issa, I. M.; Tharwat, M.; Elewady, Y. A. (Assiut Univ., Egypt). Electrochim. Acta; 17: No. 6, 1065-73(Jun 1972).

The kinetics of polarographic reduction of uranium(VI) was investigated in phosphoric acid solutions of 0.1, 1, 1.85, 5, and 10 M. In the 0.1 M acid solution two waves were obtained, whereas only one reduction wave appeared in solutions ≥M. The diffusion coefficient of the reacting species in the different media were calculated by different methods. It was concluded that reduction in these media does not go beyond quadrivalent uranium. The analysis of the different waves revealed that they are not reversible; the different kinetic parameters were calculated. The results are discussed in terms of the tendency of phosphate ions to form different complexes with U(VI) in phosphoric acid solutions of different concentrations. This is supported by spectrophotometric, conductometric studies, and adsorption by resins. (auth)

35975 APPARATUS FOR THE DECONTAMINATION OF GAS. (to Licentia Patent-Verwaltungs GmbH). British Patent 1,276,082. 1 Jun 1972. Priority date 8 Jan 1965, Germany.

Removal of radioactive or toxic suspended substances from air or other gases is described. The suspended substances are first entrained by an atomized liquid and then separated from the gas using a centrifugal separating device. (M.C.G.)

Radioactive Waste Treatment

Refer also to abstracts 35846, 35847, and 35853.

35976 FURTHER STUDIES ON INSOLUBLE COMPOUNDS AND POLYMERIZATION PHENOMENA OF NITROSYLRUTHENIUM NITRATOCOMPLEXES IN SEA WATER. Gueguenait, Pierre (Centre de La Hague, Cherbourg, France). Compt. Rend., Ser. D; 274: No. 6, 822-5(7 Feb 1972). (In French).

Since ^{106}Ru is present in radioeffluents from nuclear installations, a study was made of the nitrosylruthenium nitrato complexes formed in seawater. Two stable polymers were isolated from the insoluble compounds produced when carrier-free nitrosylruthenium nitrato complexes were introduced into seawater. Their abundances, and their high sorption possibilities, account for their special role in contaminating marine media. (France)

35977 METHOD OF DECONTAMINATING RADIOACTIVE WASTES. Verot, Jean-Louis; Jaumier, Jean-Jacques (to Ugine Kuhlmann). U. S. Patent 3,658,714. 25 Apr 1972. Priority date 4 Dec 1967, France.

A process for decontaminating liquid radioactive wastes containing Ru comprises adjusting the pH of the solution to a value between 1 and 3, percolating the solution through a column of finely divided activated iron at a rate sufficient to allow contact until the pH of the solution rises to at least 5, adjusting the pH of the solution to a value between 8 and 10, and then contacting the solution with at least one zeolite. (Offic. Gaz.)

Radioisotope Production

Refer also to abstract 35855.

35978 (KFK–1544) ACTINIDE PROJECT: SECOND SEMIANNUAL REPORT, 1971. (PACT Report 19). (Kernforschungszentrum, Karlsruhe (West Germany)). Jan 1972. 195p. (In German). Dep. NTIS (U. S. Sales Only).

ACTINIDE OXIDES—production of
ACTINIDES—production of, review on developments in
ACTIVATION ANALYSIS—neutron sources for, production of actinide
ALUMINUM ALLOYS—Al–Am, radiation effects on, irradiation program for studies on
  —Al–Pu, radiation effects on, irradiation program for studies on
AMERICIUM—separation from irradiated fuels
  —separation from curium by cation exchange
AMERICIUM ALLOYS—Al–Am, radiation effects or irradiation program for studies on
CESIUM—separation from irradiated fuels
CURIUM—separation from americium by cation exchange
CURIUM-242—production of
CURIUM-244—production of
NEPTUNIUM—separation from plutonium by solvent extraction
NEPTUNIUM-237—radiation targets of, processing of
NEUTRON SOURCES—production of actinide
PLUTONIUM—separation from neptunium by solvent extraction
  —processing of irradiated
PLUTONIUM ALLOYS—Al–Pu, radiation effects on, irradiation program for studies on
PLUTONIUM-238—purification by anion exchange
  —production of
RARE EARTHS—separation from irradiated fuels
REACTOR FUELS—reprocessing of, behavior of transuranium elements in
STRONTIUM—separation from irradiated fuels
TRANSURANIUM ELEMENTS—reactions in reprocessing of irradiated fuel
  —properties as radiation sources (M.C.G.)

35979 RAPID PROCEDURE FOR THE SEPARATION OF TECHNETIUM FROM A MOLYBDENUM MATRIX AND RUTHENIUM. Neirinckx, R. D.; de Jesus, A. S. M. (National Physical Research Lab., Pretoria). Anal. Chim. Acta; 59: No. 2, 324-7 (Apr 1972).

Extraction of Mo, Tc, and Ru from aqueous sodium hydroxide solutions with both pyridine and quaternary amines was tested. To separate ^{92}Ru and Tc from an α-bombarded Mo target, the Mo target is dissolved in a HNO_3–HCl–$NaClO_4$ mixture. Sodium hydroxide is added and the hot solution transferred to a separatory funnel containing pyridine and the mixture shaken for 1 sec. After the layers separate, Tc can be collected in the aqueous layer with 97% decontamination. (M.C.G.)

35980 SEPARATION AND CONCENTRATION OF ^{91}Y, ^{95}Zr, ^{95}Nb, AND ^{99}Mo BY COPRECIPITATION WITH IRON(III) AND MANGANESE(IV) HYDROXIDES. Novikov, A. I.; Shchekoturova, E. K.; Zakrevskaya, T. M. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 746-9(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 728-33(Sep-Oct 1971).

Radioisotopes "without a carrier," ^{91}Y, ^{95}Zr + ^{95}Nb, and ^{99}Mo (2.0×10^{-6} g-ion/liter), are entirely coprecipitated with ferric hydroxide in a 1M solution of NH_4NO_3 in the pH ranges 6 to 12.3, 3.2 to 12, and 3.5 to 6.2, respectively. The indicated pH ranges are the regions of concentration of ^{91}Y, ^{95}Zr + ^{95}Nb, and ^{99}Mo by coprecipitation with ferric hydroxide. The separation of Mo from Y and Zr + Nb is produced by coprecipitation of a mixture of these isotopes with ferric hydroxide in the pH interval 10 to 12.3; separation of ^{91}Y from ^{95}Zr + ^{95}Nb is performed by coprecipitation of a mixture of ^{95}Zr + ^{95}Nb with ferric hydroxide in the pH interval 3.2 to 4.7. ^{91}Y, ^{95}Zr + ^{95}Nb, and ^{99}Mo are coprecipitated entirely with hydrated manganese dioxide in a 1M solution of NH_4NO_3 in the pH intervals 5.5 to 12.5, 1.3 to 12.5, and 1.5 to 6, respectively; these pH intervals are the regions of concentration of the indicated elements by coprecipitation with Mn(IV) hydroxide. The separation of Mo from ^{91}Y, ^{95}Zr + ^{95}Nb is produced by coprecipitating the last elements with Mn(IV) hydroxide in the interval of pH 10 to 12; the separation of ^{91}Y from ^{95}Zr + ^{95}Nb and the separation of Zr and Nb are performed by treating the precipitate of the carrier that has sorbed the indicated elements with 0.1 N and 3 to 6 N HNO_3, respectively. The method proposed for the concentration, separation, and removal from the carrier is simple in performance, rapid (20 to 40 min), and ensures practically complete separation of the isotopes. (auth)

35981 METHOD FOR ASSAYING RADIOACTIVITY OF A RADIONUCLIDE. Deutsch, Marshall E.; Mead, Louis W.; Nagy, Zoltan (to New England Nuclear Corp.). U. S. Patent 3,657,541. 18 Apr 1972. Filed 4 Aug 1969.

The generation and testing of radionuclides, and more particularly the generation and testing of radionuclides for use in nuclear medicine are discussed. (Offic. Gaz.)

35982 PROCUREMENT AND PREPARATION OF RADIOISOTOPES AND LABELLED COMPOUNDS. Pearson, J. D. (Clinical Research Centre, Harrow, Eng.). pp 218-35 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

Advantages of preparing certain types of labeled compounds instead of attempting to purchase them are considered. Sterilization of radiopharmaceuticals, preparation of proteins labeled with ^{125}I, ^{131}I, or ^{132}I, and preparation of oleic acid, Hippuran, or olive oil labeled with ^{125}I or ^{131}I are described. Isotope cows, dispensing and handling of ^{133}Xe, and tritium labeling by exchange methods are considered. (M.C.G.)

35983 PRESENCE OF HYDROGEN PEROXIDE IN ^{18}F PREPARATIONS PRODUCED BY THE BOMBARDMENT OF WATER WITH CHARGED PARTICLES. Mudrova, B.; Svoboda, K. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 10: No. 3, 169-72(30 May 1972).

The possibility of the presence of hydrogen peroxide in fluorine 18 preparations produced by charged-particle bombardment in accelerators as well as the potential hazard for intravenous application in nuclear medicine is pointed out. The hydrogen peroxide concentration in the preparations was determined by permanganometric titration. (auth)

35984 IDENTIFICATION OF ^{78}Rb (T = 19 min). Arlt, R.; Beyer, G. J.; Herrmann, E.; Habenicht, W.; Tyrroff, H. (Joint Inst. for Nuclear Research, Dubna, USSR). Radiochem. Radioanal. Lett.; 10: No. 3, 173-5(30 May 1972).

The production of short-lived mass separated rubidium and strontium isotopes is described. The method used permitted proving that the unidentified activity with a half-life of 19 min reported earlier is due to the presence of the low spin member of the two ^{78}Rb isomeric states. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 35803, 35848, 35857, 36110, and 36564.

35985 (ANL-7917) DEVELOPMENT STUDIES ON A FLUIDIZED-BED PROCESS FOR CONVERSION OF U/Pu NITRATES TO OXIDES. PART 1. LABORATORY-SCALE DENITRATION STUDIES. Vogler, S.; Grosvenor, D. E.; Levitz, N. M.; Teats, F. G. (Argonne National Lab., Ill.). Apr 1972. Contract W-31-109-eng-38. 31p. Dep. NTIS.

Laboratory experiments were carried out to simulate the fluid-bed denitration of uranyl nitrate-plutonium nitrate solutions. These experiments indicated the denitration product to be UO_3-PuO_2, which yielded UO_2-PuO_2 upon hydrogen reduction. From this UO_2-PuO_2 product, pellets of 89% theoretical density were prepared by sintering in argon at 1600°C. Electron microprobe examination of the pellets indicated good homogeneity with no evidence of isolated particles of plutonium oxide. The cosolubility of uranyl nitrate and plutonium nitrate (1-2M U + Pu) in nitric acid was measured. The invariant point was not reached for solutions containing 0.67 fraction plutonium (Pu/U + Pu). (auth)

35986 (CONF-720522-4) REMOVAL OF RARE EARTHS FROM MOLTEN FLUORIDE MIXTURES. McNeese, L. E.; Youngblood, E. L. Jr.; Hightower, J. R. Jr.; Weeren, H. O. (Oak Ridge National Lab., Tenn.). 1972. 31p. Dep. NTIS.

From seventy-second national meeting of the American Institute of Chemical Engineers; St. Louis, MO. (21 May 1972).

Two methods were studied on an engineering scale for removing rare earths from molten fluoride salts. These methods are: vacuum distillation at 1000°C and the metal transfer process by which rare earths are extracted into bismuth solutions and lithium chloride at about 650°C. The metal transfer process is the primary method being developed for removal of rare earths from the molten salt breeder reactor. (M.C.G.)

35987 (DOCKET-50201-121) WEST VALLEY REPROCESSING PLANT. Low Level Liquid Waste Treatment Facility, Summary Report No. 6. (Nuclear Fuel Services, Inc., West Valley, N. Y.). 17 May 1972. 21p. Dep. NTIS.

All discharges from Lagoons 4 and 5 were below 2.0×10^{-5} μCi ^{137}Cs/ml. All waste water from the processing plant except the laundry and condensate was processed through the Low Level Waste Treatment Facility. ^{90}Sr concentrations of composited samples are shown. Ion exchanger performance and plant and process modifications are described. (M.C.G.)

35988 (DOCKET-50372-5) ATLANTIC RICHFIELD COMPANY REPROCESSING CENTER. Withdrawal of Application for Construction Permit for a Chemical Reprocessing Plant. (Directorate of Licensing (AEC), Washington, D. C.). 2 Jun 1972. 2p. Dep. NTIS.

35989 (IAE-2090) SEPARATION OF TRANSPLUTONIUM AND RARE EARTH ELEMENTS BY EXTRACTION WITH D2EHPA FROM DTPA SOLUTIONS. Kosyakov, V. N.; Erin, E. A. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

The extraction behavior of Am, Cm, Bk, Cf, Es, La, Ce, Pr, Pm, Sm, Eu, Gd, Ho, Yb, and Lu was investigated in the system bis(2-ethylhexyl) phosphate [D2EHPA] vs diethylenetriaminepentaacetic acid [DTPA] dissolved in lactic acid, with the aim of separating the transplutonium group and the rare earth elements. The optimum conditions of separation were found, based on the experimental results, and an actual separation of the two groups was made using extraction chromatography. The method described may be successfully used for the analytical determination of the rare earth elements, and for separating the transplutonium group of elements from irradiated samples. (tr-auth)

35990 CONTINUOUS COMBUSTION METHOD AS HEAD END STAGE FOR REPROCESSING SPHERICAL FUEL ELEMENTS FOR HIGH TEMPERATURE REACTORS. Pirk, H.; Tillessen, U. (NUKEM GmbH, Wolfgang, Ger.). Kerntechnik; 14: No. 4, 158-61 (Apr 1972). (In German and English).

For the reprocessing of spent high-temperature reactor fuels, it is desirable to burn away the graphite with oxygen. The process described is based on the unequal combustion rates of matrix graphite and of the pyrolytic carbon (PyC) coating of the particles. In the first stage of the facility, designed as a liquid-cooled shaft furnace, uncrushed elements are burned with oxygen-enriched air (30% O_2 by volume) at a temperature exceeding 1100°C. In the second stage, working as a combined fluidized and solid bed, the PyC is burned also with oxygen-enriched air at 1000°C. The throughput of the pilot plant is 80 spheres per hour. The possibilities are discussed of scaling up the process and for treating block elements. (auth)

35991 SEPARATION OF URANIUM AS UF_6 FROM MIXTURES OF U/Th CHLORIDES BY FLUORINATION IN THE CONTEXT OF DRY REPROCESSING OF THORIUM CONTAINING NUCLEAR FUELS. Kreutz, R.; Kuhrt, W.; Massonne, J. (Kali-Chemie AG, Hanover). Kerntechnik; 14: No. 4, 162-5 (Apr 1972). (In German and English).

The uranium contained in U/Th chloride mixtures can be volatilized as UF_6 by a sequence of hydrofluorination, in which the reaction temperature is increased slowly from 25 to 250°C, followed, by fluorination at 600 to 700°C, down to a residual content of 0.11 to 0.03% depending on the composition of the original mixture. (auth)

35992 PNC REPROCESSING PLANT. FIRST PLANT OF JAPAN. Miyoshi, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Genshiryoku Kogyo; 18: No. 1, 10-18(Jan 1972). (In Japanese).

PNC's fuel reprocessing plant, Japan's first, is described mainly from engineering aspects. The capacity of the plant is 700 kg U/day, and the procedure is by the wet Purex process. It can treat fuel from light-water reactors and also natural uranium. The following are described: mechanical and chemical processes; safety control and design, including containment, criticality, fire, etc.; construction of the plant, including cells and shields and aseismatic design; metallic materials used in construction and their welding, such as stainless steel; control, instrumentation and design of the process, physical measurement, composition measurement, etc. (Japan)

35993 NECESSITY AND PROBABILITY OF CLOSED LOOP REPROCESSING PLANT. Tateno, J. (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 18: No. 1, 30-4(Jan 1972). (In Japanese).

Radiation safety in fuel reprocessing plants is discussed. The possibility for making the radioactive release from PNC's plant near zero is described, taking up the problems involved and recent development in this field. (Japan)

35994 SAFEGUARDS OF REPROCESSING FACTORY. Nakajima, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Genshiryoku Kogyo; 18: No. 1, 19-23(Jan 1972). (In Japanese).

Fuel reprocessing plants are generally divided in three areas: that is, pre-treatment including receiving; processing including purification and fabrication; and product storage. This division is also convenient for safeguards of the fuel reprocessing plants. In the first and third areas, containment and surveillance are carried out; and in the second area, input and output and store are checked. The type of safeguards for reprocessing plants, measuring points in the plant and measuring methods, analysis of the measuring scheme, and development on the safeguard techniques are described. (Japan)

35995 CHANGE IN THE EXTRACTION PROPERTIES OF N-BENZYLALKYLAMINES AND TRI-n-OCTYLAMINE UNDER THE ACTION OF IONIZING RADIATION. Makarov, G. V.; Egorov, G. F.; Zagorets, P. A.; Kershulis, V. I.; Vinetskaya, T. N. This paper was summarized in At. Energ. (USSR); 30: No. 3, 299(Mar 1971) as paper No. 470/5731. (In Russian).
Full copy of this paper is held by TIC.

The influence of x radiation on the extraction of U(VI), thorium, Pu(IV), zirconium, and ruthenium from aqueous 2M solutions of nitric acid with 0.2M solutions of dibenzyldodecylamine, benzyldinonylamine, and tri-n-octylamine nitrates in n-octane with 15% by weight n-octyl alcohol and in n-butylbenzene was studied. The extraction behavior of the elements varied little in the range of investigated doses (3×10^{19} to 5.5×10^{20} eV/ml). An increase in the distribution coefficients with increasing absorbed dose was observed only in the extraction of zirconium. The re-extraction of all the elements (except for zirconium) from irradiated solutions occurred satisfactorily. The retention of plutonium and ruthenium in the organic phase after one-step re-extraction with an equal amount of a 5% solution of Na_2CO_3 did not exceed 3 and 8%, respectively, for solutions of the amines in n-octane and 5 and 18% for solutions of the amines in n-butylbenzene. The extraction characteristics of the alkyl aromatic amines investigated corresponded closely to the characteristics of aliphatic tri-n-octylamine. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 36014, 36016, and 36042.

35996 (GMAD–3587-23) RADIANT ENERGY CONVERSION. Final Report. (General Motors Corp., Indianapolis, Ind. Allison Div.). 10 Mar 1967. Contract AT(30-1)-3587. 155p. Dep. NTIS.

Declassified 2 Nov 1971.

Results are presented for an 18-month program which continued the feasibility study of the radiant energy conversion (REC) concept. This REC concept uses photovoltaic cells to convert thermal radiation from a contained source to electrical energy. The objectives of the follow-on program were to improve the performance of system components, conduct irradiation tests to evaluate photovoltaic cell performance, and fabricate and evaluate interference filters to control energy loss. Performance data are presented for a spectrally selective emitter coating that was stable above 1300°K. A predicted system efficiency of 7% was obtained at 1400°K. It was an improvement over the device developed during the first contract which required a higher operating temperature (1825°K) to provide a system efficiency of only 5.3%. Results of tests at the Oak Ridge National Laboratory on photovoltaic cells in a ^{144}Ce gamma radiation field indicated that cell output was affected more by the dry ambient gas than by degradation from gamma radiation. The 3-mil thick P/N^+ alloyed-junction cells showed the best radiation tolerance (3.2% power degradation) during the six-month evaluation. Interference filter structures were deposited on both diffused- and alloyed-junction cells. The diffused-junction cells provided satisfactory results for use in a vacuum environment. However, the surfaces of the alloyed-junction cells, which were sensitive to the loss of absorbed moisture, were not successfully passified for use in a vacuum. The REC concept is shown to be feasible as a method of direct energy conversion. The performance demonstrated for this concept warrants additional experimental effort to attain system optimization. (auth)

35997 PLASMA MAGNETOHYDRODYNAMIC GENERATORS WITH THE USE OF OXYGEN AND AERODYNAMIC PROTECTION. Shchegolev, G. M. Vestn. Akad. Nauk Ukr. RSR; No. 11, 19-25 (Nov 1971). (In Russian).

A method for protecting the MHD generator duct by the injection of an inert gas through its walls is described. Several MHD duct designs have been proposed in which the electrode or insulating walls are to be porous or formed with protection against the destructive effect of the plasma stream by the injection of gas (aerodynamic protection). To study some of the questions involved, an analytical investigation was made of the power efficiency of power station schemes which have an MHD generator with aerodynamic duct-wall protection, as well as an experimental investigation to determine the effect of the injection of neutral gases (nitrogen, argon) on the electrical characteristics of porous generator electrodes. A comparison was made of the power efficiency of schemes with injection and with external cooling. Experiments were performed to determine the effect of the injection of pure nitrogen and argon on the electrical parameters of porous cermet electrodes. The porous materials for the experimental electrode specimens were developed and prepared. The results indicate that there is an 80- to 100-fold decrease in the erosive wear of materials as compared to erosion without injection, the cathodic potential drop is not intensified and depends only on the temperature and properties of the electrode material, and the current density range in which a stable arcless operating mode is possible expands somewhat. The power efficiency of an MHD generator with aerodynamic protection matches a cycle with external duct cooling even under the most adverse assumptions. Aerodymamic protection is very effective from the standpoint of eliminating duct erosion and corrosion and, to a lesser extent, also improves conditions for the passage of current. (auth)

35998 MAGNETOHYDRODYNAMIC GENERATOR WITH ALTERNATE LIQUID AND GAS LAYERS. Masse, Jean (to Electricite de France, Service National). French Patent 2,067,934. 26 Jul 1971. Filed 21 Nov 1969. (In French).

A MHD generator is described. The generator utilizes a high conductivity fluid and has a satisfactory thermodynamic cycle, which does not require the production and breakdown of an emulsion, and which reduces the technological problems associated with the construction of the MHD nozzle. The generator possesses a closed loop in which a fluid circulates. This loop is divided into sections: a divergent section in which the fluid expands, which possesses a nozzle, a section for compressing the fluid with a constant section. The loop is provided with a MHD pump, which drives back the fluid. The hot pulsed gas supplying the initial energy (gas heated by nuclear reactor) is introduced above the first section and leaves below this section. The mechanical energy of the gas is transferred by contact to the moving liquid in the divergent section and then into electrical energy in the nozzle. The electrical conductor is the liquid conductor (molten salts e.g., alkali salts). (France)

Facilities and Equipment

Refer also to abstract 37391.

35999 (BDX–613-563(Rev.)) INSPECTION OF FINE-PITCHED GEARS. Final Report. Berry, C. W. Jr. (Bendix Corp., Kansas City, Mo.). Mar 1972. Contract AT(29-1)-613. 47p. Dep. NTIS.

A project is described that is designed to develop and evaluate rolling gear checking systems having capabilities greater than are currently possible with commercial equipment. The capability of commercial rolling gear checking machines and the AEC complex capability for measuring master gears were determined. A rolling gear checking machine that exceeds Bendix requirements was developed. This machine is capable of testing fine-pitched gears between 0.5 and 8 ounces, and of detecting changes in pitch diameter with an accuracy of 0.000030 inch at a 3σ confidence level. This increased capability was obtained by reducing the mass of moving members, using a pivot motion to reduce friction, and using an air-actuated gaging transducer to provide the necessary gaging pressure and electronic readout. Although the ±0.000240-inch accuracy at a 3σ confidence level of the master gear calibration fixture is not adequate for Bendix calibration needs, the knowledge gained from evaluation of this system can be used for the design of a satisfactory system. (auth)

36000 (BDX–613-602(Rev.)) HAND TOOL FOR INSTALLING SOLDER FORMS OVER COMPONENT LEADS. Final Report. Bowlen, D. W. (Bendix Corp., Kansas City, Mo.). Feb 1972. Contract AT(29-1)-613. 29p. Dep. NTIS.

The trend in recent months has been to use solder forms for hand soldering of components on printed wiring assemblies (PWA's). These forms may be purchased in any desired shape or size, depending upon the application and the amount of solder required. The shape of the solder forms used on current PWA's is round and flat, with a hole in the center. Solder forms are used by placing a form over each component lead that is to be soldered. Flux is added, and heat is applied with a soldering iron. The solder form melts and flows into the eyelet and around the component lead. The present method of installing solder forms employs special slotted-tip tweezers. A hand tool for rapid, convenient installation of solder forms over component leads has been developed. The tool, called "Hand Tool, Installer, Solder Forms (Rings)," ejects a single solder form when squeezed between the thumb and middle finger of the operator. It has a capacity of 150 of the presently-used solder forms. It is small and lightweight, and can be used equally well by either right- or left-handed operators. The tool can be modified for dispensing other small-part configurations such as ball bearings, snap rings, nuts, washers, wafers, and similar small pieces. (auth)

36001 (FXM–6725) MOTOR DATA FOR SNAP-50/SPUR SYSTEM STUDIES. Cooper, K. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advaned Nuclear Engineering Lab.). 25 Sep 1963. Contract AT(30-1)-2789. 4p. Dep. NTIS.

Declassified 28 Oct 1971.

Motor data for SNAP-50/SPUR system studies are presented. Motor data contained in this memorandum supersede all previous motor data for 12,000 rpm, and should be used until such time as additional motor data are available. The results of an evaluation of available motor data are shown in the curves of weight and power factor versus horsepower. (auth)

36002 (SC–RR–720212) ABSORBED GAMMA DOSE RATES IN THE NORTH CELL OF THE GAMMA IRRADIATION FACILITY (GIF). Huston, J. E. (Sandia Labs., Albuquerque, N. Mex.). Mar 1972. 20p. Dep. NTIS.

The photon environments in the north cell of the Gamma Irradiation Facility (GIF) have been measured using cobalt glass and 4-chlorostyrene dosimeters. The 4-chlorostyrene data were confirmed by using dosimetry material calibrated by the National Bureau of Standards on November 23 to 24, 1971. The maximum absorbed dose rate measured in the north cell of the GIF was 1.92×10^5 rad/min (water) inside the source array. (auth)

36003 (SFB-MHD-4) THEORY AND DESIGN OF THREE-LEGGED AC CONDUCTION PUMPS FOR LIQUID METALS. Schulz, T. (Technische Universitaet, Berlin (West Germany)). Jul 1971. 40p. (In German). Dep. NTIS (U. S. Sales Only).

Electromagnetic ac conduction pumps for liquid metals are used to an advantage in the form of three-legged core structures. The design is based on a transformer with a leakage yoke. The secondary current crosses the pump channel, and the leakage yoke produces the channel magnetic excitation. There is an interaction between the current and the magnetic field in the channel; relations treated in detail include a vector diagram of the voltages, along with discussions of currents and magnetic fluxes. These basic explanations are used to develop a usable design method which can be applied to a small pump for a feed pressure of about 0.1 bar and a flow rate of 0.1 m^3/h. The possibility of an essential improvement of this pump type based on the fact that the flux reducing effect of the armature reaction can be inverted, resulting in a triply increased rated output. (auth)

36004 (Y-SC-37) MACHINING AND GAGING INFORMATION 1971 ANNUAL INDEX. Read, A. M.; Simpson, D. L. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 28 Apr 1972. Contract W-7405-eng-26. 210p. Dep. NTIS.

An index is presented which contains a compilation of all information entries to the M.A.G.I.C. data base during Calendar Year 1971. The volume consists of five sections: a title index, a key word index, an author index, a corporate author index, and a bibliographic section. Each bibliographic entry is arranged according to corporate author and includes a title, personal author, report designation, abstract, report availability, and key word descriptors. (auth)

36005 MRCH-γ-25M ISOTOPIC GAMMA IRRADIATION PLANT FOR RESEARCH IN MICROBIOLOGY AND RADIATION CHEMISTRY. Kaushanskii, D. A. (Isotopenpraxis; 7: No. 8, 349-50(Aug 1971). (In German).

An irradiation device for microbiology and radiation chemistry is described. It consists of three chambers, one of which is designed for pressures up to 10 atm and a second for pressures up to 100 atm. The third chamber contains channels for thermostating. Each container also has up to 2 channels for electrical power and thermoelectric sensors. The irradiation chamber can be charged with a total activity of from 2300 to 16,200 Ci. The design parameters of the device are tabulated. The relationship between the total activity and the radiation dose in the center of the chamber, and also the dose field in the irradiation chamber are shown. (J.S.R.)

36006 MULTIPARAMETER CELL SEPARATOR (Apr 1972) (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-2201)
24 drawings.

A high-speed multisensor cell analysis and sorting system for use in biomedical research that has potential application for automated analysis and sorting of normal and cancer-related populations according to electro-optical sensed physical and chemical-cellular properties is described. Cells stained by a fluorescent Feulgen method are introduced into a dual-sheath flow chamber where electronic and optical sensors measure cell volume, light scatter, and fluorescence. (For details see TID-4100 Suppl. 70). (F.S.)

36007 LOW-VELOCITY AIR GUN (18 Nov 1969) (Engineering Materials). (California Univ., Livermore. Lawrence Radiation Lab.). (CAPE-2195).
57 drawings.

A low-velocity air gun, used to study the mechanical properties of materials under dynamic loading, usually under the condition of one-dimensional stress, is described. Specimen materials may be inert, reactive such as high-explosives, or toxic such as beryllium. The apparatus is dependable, versatile, relatively inexpensive, and permits experiment completion in short periods of time. The gun is capable of firing solid projectiles at velocities ranging between 50 and 1500 in./s depending on projectile design and the air pressure in the reservoir. With light, hollow projectiles, it is possible to attain velocities up to 5000 in./s. (For details see TID-4100 Suppl. 70) (see also 25: 57289). (F.S.)

Heat Transfer and Fluid Flow

Refer also to abstract 36533.

36008 (AAEC/LIB/Bib-313) EFFECT OF PRESSURE, SURFACE ROUGHNESS, AND ROD SPACERS ON BURNOUT IN CHANNELS BUT NOT IN POOL BOILING. A Bibliography. Geue, J. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1971. 53p. INIS.

Two hundred and eighty two references are listed covering the period 1962 to September 1971. The references are arranged chronologically by year and alphabetically by author within each year. Reference is made to an abstract for each citation. (INIS)

36009 (AEC-tr-7210) HEAT TRANSFER IN BOILING METALS BY NATURAL CONVECTION. Subbotin, V. I.; Sorokin, D. N.; Ovechkin, D. M.; Kudryavtsev, A. P. Translation of Teploobmen pri Kipenii Metallov v Usloviyakh Estestvennoi Konvektsii, Izdatel'stvo Nauka, Moscow, 1969. 171p. (TT-71-50051; IPST-Cat.-5997). Dep. NTIS.

Experimental methods are presented for studying heat transfer during pool boiling of metals. The results of Russian and non-Russian studies of heat transfer and of the critical heat flux during pool boiling of metals are discussed. The material presented is divided into four categories: equipment and methods for studying heat transfer during boiling of metals; heat transfer theory and a comparison of theoretical and experimental results; critical heat flux in pool boiling of nonmetallic and metallic liquids; and some problems in the physics of boiling metals. A 215-item bibliography is included. (L.C.L.)

36010 (AEC-tr-7211) HEAT AND MASS TRANSFER IN TECHNOLOGICAL PROCESSES. Lykov, A. V. (ed.). Translation of Issledovanie Teplo- i Massoobmena v Tekhnologicheskikh Protsessakh i Apparatakh, Izdatel'stvo Nauka i Tekhnika, Minsk, 1966. 269p. (TT-71-50052; IPST-Cat.-5998). Dep. NTIS.

Forty-three papers of Russian theoretical and experimental studies of heat and mass transfer in fluidized beds are compiled. The subjects discussed include: the gas flow and mixing characteristics of fluidized beds, uses of fluidized beds in drying processes; effects of moisture content on physical properties of the flowing media; aerosol deposition for turbulent flow in various shaped channels; and heat transfer in gas-suspension flow. (L.C.L.)

36011 (EUR-4785) STUDY OF A TWO-PHASE LIQUID FLOW FROM A PIPE OF CIRCULAR CROSS-SECTION AND EXPERIMENTAL MEASUREMENTS OF THE RESULTING MOMENTUM. Friz, G.; Candolfo, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 1972. 86p. (In Italian). Dep. NTIS (U. S. Sales Only). EUR FB 125,-.

The momentum of a two-phase (water-vapor) flow was experimentally determined by measurement of the reaction forces on the containment. The flow coming from a pressurized vessel with a volume of about 2 liters passes through a straight tube (10 mm dia.) and is then blown out in free atmosphere. The parameters were: pressure (2 to 12 atm.), water temperature (20 to 180°C) and tube length (0.25 to 2 m). The experimental results are compared with a theoretical model which was previously developed on the basis of mass flow rate measurements. (auth)

36012 (FRNC-CONF-23) INDUSTRIAL PROBLEMS IN WHICH NATURAL CONVECTION IS IMPORTANT. Grossin, M. (Societe Bertin et Cie, Plaisir (France)). 1971. 25p. (In French). (CONF-710939-4). Dep. NTIS (U. S. Sales Only).

From Conference on natural and mixed convection and its industrial application; Ermenonville, France (13 Sep 1971).

Two cases in which natural convection is used to remove heat are considered. The characteristics of a finned radiator used to maintain power transistors at an acceptable temperature are given. The importance of determining the exchange coefficient in calculating the thermal characteristics of irradiated fuel transport casks utilizing a gaseous coolant to remove the residual power (casks of Chinon $^2/_3$ and Saint-Laurent des Eaux) is discussed. Industrial problems in which convection is considered a nuisance are subsequently considered. Calculations concerning the porous thermal insulation of a pressurized CO_2 reactor (asymptotic and boundary layer conditions) are briefly discussed. The thermal insulation used for the building is also discussed. (France)

36013 (KFK-1549) RESULTS OF HEAT TRANSFER AND PRESSURE DROP MEASUREMENTS WITH HELIUM IN A 16-TUBE BUNDLE. Marek, J.; Maubach, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Jan 1972. 39p. (In German). Dep. NTIS (U. S. Sales Only).

Results are reported of measurements performed with respect to pressure drop and heat transfer of helium at a pressure of 43 ata flowing through a bundle of 16 tubes in a square arrangement. The tubes were heated by direct current; the heating power was from 110 to 295 kW corresponding to a power of 40 to 105 W/cm at the heating tube. The tubes were smooth and arranged in a smooth square channel at a distance ratio of p/d = 1.283. The Reynolds numbers ranged from 1.5×10^4 to 1.4×10^5. Wall temperatures up to 550°C were measured. The isothermal friction coefficients of the entire bundle, including the channel wall, were determined to be about 2% higher than that of the circular tube. The Nusselt numbers for the central channel were slightly smaller than the comparable values of circular tubes. (auth)

36014 NUMERICAL METHOD FOR SOLVING GENERAL MHD DUCT FLOW PROBLEMS. Chu, Wen-hwa (Southwest Research Inst., San Antonio). J. Appl. Mech.; 3: No. 18, 47-52(Mar 1972).

A numerical method is successfully developed for solving general MHD duct flow problems, utilizing "machine transformation" and finite-difference technique with a new successive overrelaxation procedure. Examples are given to establish the method and to indicate the versatility of the associated computer program. The generality of the basic principle may help to solve many problems other than MHD flow in a general domain. (auth)

36015 AUGMENTATION OF HEAT TRANSFER IN GASES AND LIQUIDS FLOWING IN TUBES. Kalinin, E. K.; Yarkho, S. A. (Moscow Aviation Inst.). Heat Transfer - Sov. Res.; 4: No. 2, 79-86(Mar-Apr 1972).

Results are presented of an experimental study of heat transfer and resistance in smooth tubes and in tubes with flow turbulence promoters over ranges of Re = 500 to 2×10^5 and Pr = 0.7 to 50 for heating and cooling. It is shown that the suggested method of heat transfer augmentation is quite promising over a wide range of Reynolds numbers and makes it possible to markedly reduce the dimensions of heat transmitting surfaces of tubular heat exchangers with the same pressure loss. Design recommendations are presented on heat transfer and pressure loss in the form of dimensionless equations which, together with recommendations on the selection of optimum dimensions and the location of the turbulence generators make it possible to carry out engineering calculations in designing heat exchangers with high-efficiency heat transfer surfaces. (auth)

36016 CONDENSATION OF CESIUM VAPOR FROM A FLOW OF ARGON. Borishanskii, V. M.; Peleev, I. I.; Aref'ev, K. M.; (and others) (Polzunov Boiler and Turbine Inst., Leningrad). Heat Transfer - Sov. Res.; 4: No. 2, 87-93(Mar-Apr 1972).

The condensation is considered of small admixtures of cesium (cesium seed) from the flow of argon when fog formation is possible. Experiments were carried out with condensation of cesium from laminar tube flow. It was found that the relative precipitation on walls decreases with increasing inlet concentration of cesium. An optimal wall temperature was found to exist. The precipitation is lower at higher as well as at lower temperatures. All this is due to fog formation. The bulk of the experiments was carried out with a tube bundle in transverse flow of cesium-seeded argon. The tubes in the bundle were staggered, and were 12 mm in diameter. The relative frontwise pitch was 2, the depthwise pitch was 1.5. The tubes were cooled by air from the inside. The Reynolds numbers based on the tube diameter ranged from 1200 to 3000, the inlet temperature of the argon ranged from 543 to 623°K, the cesium concentration ranged from 2×10^{-4} kg/kg to 11×10^{-4} kg/kg. The relative deposition was 35 to 45% from the amount of supplied cesium. The cesium condensation was calculated. It was assumed that there is no precipitation in the region where the fog forms, while before the fog formation zone the condensation at the tube surfaces occurred by means of diffusion. The calculated results are in agreement with applicable experimental data. (auth)

36017 LINEARIZATION OF SPARROW AND KOOPMAN'S METHOD FOR HEAT TRANSFER WITH VARIABLE CONDUCTIVITY. Dixmier, Marc (CEN, Saclay, France). Nucl. Sci. Eng.; 48: No. 1, 121-2(May 1972).

It has been shown that the heat conduction equation could be made linear by choosing the integrated conductivity, instead of the temperature, as the unknown; unfortunately, the boundary conditions for this variable, at the interface between solid and coolant, become nonlinear. A linear representation of these conditions is proposed, based on the notion of an effective coolant temperature, which removes this difficulty; the accuracy of such a representation is demonstrated. (auth)

Materials Testing

Refer also to abstracts 36182, 36197, 36313, 36316, and 36602.

36018 (LA-4724) ACOUSTIC EMISSION TESTING PROGRAM: PROGRESS REPORT ON TENSILE TESTING THROUGH OCTOBER 1970. Schuyler II, D. R.; Feiertag, T. H. (Los Alamos Scientific Lab., N. Mex.). Mar 1972. Contract W-7405-eng-36. 39p. Dep. NTIS.

Development of an acoustic emission testing program was initiated to broaden the nondestructive testing capability of the Laboratory. Acoustic emission is created in materials as they undergo stress relief mechanisms and may be detected by high gain electronic amplification equipment. A program of conducting tensile tests on various materials while monitoring with acoustic emission equipment was undertaken. This furnished background information which would be useful for predicting and evaluating acoustic emission behavior of structures was more complicated than tensile samples. (auth)

36019 (RFP-Trans-96) DETERMINATION OF THE DELTA-FERRITE CONTENT IN AUSTENITIC STEELS ACCORDING TO A RADIOGRAPHIC PROCESS AND COMPARATIVE STUDIES WITH MAGNETIC AND METALLOGRAPHIC METHODS. Suwalski, Guenter; Haupt, Heinz. Translated for Dow Chemical Co., Rocky Flats Div., from Neue Huette; 13: No. 9, 527-31(Sep 1968). 11p. Dep. NTIS.

For the determination of the ferrite content in austenitic steels, the diffractometer method and the metallographic method were used. In comparison, the diffractometer method proved more suitable, since in this method a considerably larger area is used in determining the ferrite content. This is of great importance, since the distribution of the ferrite in the sample is not uniform. In addition, the determination of ferrite content by the diffractometer method can be carried out in a shorter time than by metallography. It is therefore best to use the diffractometer method for individual measurements and for the determination of the ferrite content of standard samples. The ferrotest machine which operates destruction-free and on the basis of the scan-rinse method makes possible the considerably more rapid determination of the ferrite content in austenitic steels. This is a relative method, however, and standard samples with known ferrite contents must be used to prepare a calibration curve for each quality of steel. This method can be applied in series tests and for pieces of larger dimensions from which no samples can be removed. (auth)

36020 IMPROVEMENTS IN OR RELATING TO THE RADIOGRAPHY OF WELDS. Rooney, John (to United Kingdom Atomic Energy Authority). British Patent 1,272,404. 26 Apr 1972. Filed 16 Oct 1968.

Particular reference is made to the radiography of a curved weld, such as at the joint between a tube and supporting tube-plate of a heat exchanger. Radiography of such a weld gives rise to several difficulties. The film employed should preferably be held in contact with the weld surface, but this is difficult to achieve with a curved weld. It is also difficult to position a radiation source on the weld side of a tube in a tube and plate assembly because of the proximity of adjacent tubes. In the technique described a radiation transparent sleeve, such as of Perspex, is fitted on to the tube, and the film is located on the outer surface of the sleeve. The radiation source is located on the line of the longitudinal axis of the tube to provide a beam of radiation that traverses the weld and is recorded on the film. The sleeve is preferably shaped at one end to fit about the weld surface so that it also seats on the surface of the tube-plates. (UK)

36021 CREEP CELL WHICH IS PRIMARILY INTENDED FOR USE IN NUCLEAR REACTORS. Cartier, Louis (to Commissariat a l'Energie Atomique). British Patent 1,275,887. 24 May 1972. Priority date 29 May 1970, France.

A creep cell for studying time-dependent deformations of materials as a function of tractive force and irradiation in nuclear reactors is described. (W.H.K.)

Nuclear Explosions

36022 (AWRE-O-32/72) SOME SEISMIC RESULTS OF 12 UNDERGROUND NUCLEAR EXPLOSIONS AT THE NEVADA TEST SITE, USA. Shot Report No. 4. Gibbs, P. G.; Blamey, C. (Atomic Weapons Research Establishment, Aldermaston (England)). Mar 1972. 27p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

Seismic data are provided from 4 UKAEA sponsored arrays of 12 nuclear explosions detonated underground at the Nevada Test Site. The locations, depths, source media, and yields of these explosions have been published by the USAEC. (auth)

36023 (CEA-R-4287) DISTRIBUTION OF RADIOACTIVITY IN THE ENVIRONMENT OF AN UNDERGROUND NUCLEAR EXPLOSION. AN ATTEMPT TO SYNTHESIZE THE RESULTS OF RADIOCHEMICAL ANALYSIS CONCERNING THE HOGGAR EXPERIMENTS. Van Kote, Francis; Balard, Francois (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Apr 1972. 33p. (In French). Dep. NTIS (U. S. Sales Only).

The results of radiochemical analyses associated with the Hoggar experiments are presented as part of an experimental and theoretical research program on the distribution of radioactivity around the French contained underground nuclear explosions. From the definition of the volatility index of ^{144}Ce (considered to be perfectly refractory), a classification system for the fission products is developed and estimations of their level of retention by the lavas are made. Some information is given on the behavior of the activation products. Although the data can be interpreted in a more general way, the conclusions drawn concern only the cavity and the immediate vicinity in the granitic medium. (auth)

36024 (FOA-4-4486-A-1) U. S. NUCLEAR EXPLOSION CANNIKIN, NOVEMBER 6, 1971. Event Report No. 1. (Hagfors Observatory, Stockholm (Sweden)). Mar 1972. 12p. Dep. NTIS (U. S. Sales Only).

The seismic data obtained at the Hagfors Observatory in Sweden from the U.S. nuclear explosion Cannikin on Nov. 6, 1971, are presented and include the recorded short- and long-period signals, their spectra, and the surface wave dispersion curves. (auth)

36025 (JAB-99-107) SURVEY OF BRIDGES SUBJECTED TO STRONG GROUND MOTIONS FROM THREE UNDERGROUND NUCLEAR EXPLOSIONS. Hakala, W. W. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Apr 1972. Contract AT(26-1)-99. 107p. Dep. NTIS.

Thirty one (31) bridges that were subjected to relatively high peak acceleration levels ($\gtrsim$.1g) for three (3) underground nuclear detonations were re-examined for documentation purposes. The three nuclear detonations were the Salmon event (Mississippi), the Gasbuggy event (New Mexico), and the Rulison event (Colorado). None of these bridges were damaged structurally because of the detonations. Photos, dimensions, and construction materials of the bridges are given in the report. Also included are the peak ground motions experienced by the bridges. It is concluded that high acceleration levels by themselves are not sufficient to cause damage. (auth)

36026 (NVO-362-15) SITE LOCATION AND CALIBRATION DATA: WATER WAVE AND IN-WATER GROUND MOTION INSTRUMENTS, PROJECT CANNIKIN. (General Motors Corp., Santa Barbara, Calif. Delco Electronics Div.). Feb 1972. Contract AT(26-1)-362. 89p. Dep. NTIS.

Information on the location and calibration of instruments used to measure the in-water ground motion and water waves during the Cannikin Event at Amchitka Island, Alaska on Nov. 6, 1971 is presented. Pertinent information on the instruments is also included and will aid in the analysis of the data recorded during the event. Calibration measurements were made of the island uplift and resultant run-off at four locations on Amchitka and on three nearby islands, in-water ground motions along the Amchitka shores, and tidal conditions. (L.C.L.)

36027 (NVO-1163-63) PRE-SCHOONER II. Interim Report. (Beers (Roland F.), Inc., Alexandria, Va.). 29 Oct 1965. Contract AT(29-2)-1163. 17p. Dep. NTIS.

Ground motion data recorded at 8 stations near the Pre-Schooner II Event in Idaho are presented. Peak motions were measured and plotted versus distance for comparison with predictions. Usable data were obtained at all 8 stations. The 2 stations which recorded acceleration provided data which agree quite well with predictions. The observed displacements and velocities were both higher than predicted. Additional data processing is required to correct for the frequency response characteristics of the instruments and to derive accelerations, displacements, and velocities at each station. (L.C.L.)

36028 (NVO-1163-232) ANALYSIS OF CANNIKIN SEISMIC DATA. Orphal, D. L.; Smookler, S. (Environmental Research Corp., Las Vegas, Nev.). Apr 1972. Contract AT(29-2)-1163. 71p. Dep. NTIS.

The amplitude and spectral characteristics of the Cannikin seismic motion recorded in the distance range 10 to 370 km agree well with predetonation predictions based on extrapolation of data observed from Milrow. The yield and distance scaling equations used for extrapolation are based on statistical analyses of ground motion data recorded from numerous Nevada Test Site explosions. Yield scaling of seismic motion for high-yield underground nuclear explosions is examined using data recorded from Cannikin and Milrow. The seismic spectrum scaling model for underground nuclear detonations formulated by Mueller and Murphy (1971) predicts yield scaling exponents that are yield-dependent. Seismic data recorded at Adak and Shemya Islands from both Cannikin and Milrow were reduced to obtain empirical yield scaling exponents as a function of frequency for explosions spanning a yield range of approximately 1,000 to 5,000 kt. Although there is significant scatter in the data, these empirical yield scaling exponents are in reasonably good agreement with those calculated on the basis of the theoretical model. In addition, the effect of yield dependence of yield scaling, an effect not incorporated in the Cannikin predictions, explains small but consistent deviations between the observed and predicted Cannikin ground motion. (auth)

36029 (PNE-RB-11(Vol.1)) BIOLOGICAL/ECOLOGICAL CONSIDERATIONS FOR PROJECT RIO BLANCO. VOLUME I. PRE-EVENT INVENTORY AND POTENTIAL IMPACT ANALYSIS. Schiager, Keith J.; Johnson, James E.; Watters, Robert L.; Whicker, F. Ward (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). Jul 1971. 219p. Dep. NTIS.

For CER Geonuclear Corp., Las Vegas, Nev.

Prior to the Rio Blanco Event an environmental inventory was taken of the northwest Colorado area near the site. This inventory included data related to the atmosphere, biosphere, hydrosphere, and lithosphere. The potential environmental perturbations expected from the seismic and radiological effects of Rio Blanco were anticipated. Predictions were made of the expected radiation dose from the explosion and from seepage and flaring of radioactive gas from the explosion cavity. After investigating the current environmental conditions of the area, reviewing environmental surveillance data from the Gasbuggy and Rulison Events, and calculating the radiation dose to humans expected for the Rio Blanco Event, it was concluded that: the potential radiation doses to humans are very small; there is a possibility of seismic damage to native vegetation, but it cannot be estimated quantitatively; water quality in the area may be temporarily adversely affected by the detonation; and the construction work and traffic required by the project will produce a greater environmental detriment than will radiation and seismic shock combined. It is recommended that: radiation monitoring be performed before and after detonation; that substantial efforts be made to evaluate any seismic effects on vegetation; that pre- and post-event water quality evaluations be made; and that human activities be confined to the least number of locations and smallest area possible in order to have the minimum effect on the land and the wildlife. (L.C.L.)

36030 (PNE-RB-12(Vol.2)) BIOLOGICAL/ECOLOGICAL CONSIDERATIONS FOR PROJECT RIO BLANCO. VOLUME II. APPENDICES CONTAINING ENVIRONMENTAL INVENTORY DATA FROM VARIOUS SOURCES. Schiager, Keith J.; Johnson, James E.; Watters, Robert L.; Whicker, F. Ward (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). Jun 1971. 348p. Dep. NTIS.

For CER Geonuclear Corp., Las Vegas, Nev.

Five appendixes containing environmental inventory data for the northwest Colorado region near the Rio Blanco site are presented. Information is included on climate, topography, hydrology, vegetation, soils, geology, minerals, timber, livestock forage, watershed, water uses, wild life populations of fish, birds, and mammals, and recreation facilities. (L.C.L.)

36031 (PNE-RB-13) RIO BLANCO SHOT: PRELIMINARY EVALUATION OF OPERATING MINES WITHIN 53-MILE RADIUS OF THE EMPLACEMENT WELL. (CER Geonuclear Corp., Las Vegas, Nev.). [nd]. 33p. Dep. NTIS.

A safety evaluation was made on each of 13 mines located within a 53 mi.-radius of the Rio Blanco ground zero to determine what blast damage might occur and what safety precautions should be taken. A separate report is presented for each mine. (L.C.L.)

36032 (PNE-RB-15) RIO BLANCO DEMONSTRATION PROGRAM. (CER Geonuclear Corp., Las Vegas, Nev.). 20 Jan 1972. 17p. Dep. NTIS.

Following a feasibility study of the potential for using nuclear stimulation technology for the recovery of otherwise unavailable natural gas reserves, a joint industry-government demonstration program for the Rio Blanco Project was undertaken. The demonstration program included three phases. The first required the simultaneous detonation of three nuclear explosives in a single well. The second called for the sequential detonation of multiple explosions in 4 to 6 wells. The third phase would use sequentially detonated multiple explosions in 20 to 60 wells. The activities and schedules required for completing each phase, the test data desired, and methods for evaluating the results from each phase are discussed in detail. (L.C.L.)

36033 (PNE-RB-16(Vol.1)) PROJECT RIO BLANCO DEFINITION PLAN. VOLUME I. PROJECT DESCRIPTION. (CER Geonuclear Corp., Las Vegas, Nev.). 14 Feb 1972. 74p. Dep. NTIS.

A description is given of the Rio Blanco Project for demonstrating the feasibility of using underground nuclear explosions to stimulate production of natural gas from a reserve in Colorado.

Information is included on: the characteristics of the site; design of the experiment; environmental impact evaluation; activities related to detonation and to reentry and production testing; and the administration and scheduling of the project. (L.C.L.)

36034 (PNE-RB-17(Vol.2)) PROJECT RIO BLANCO DEFINITION PLAN. VOLUME II. DETONATION-RELATED DETAILED TASKS. (CER Geonuclear Corp., Las Vegas, Nev.). 2 Mar 1972. 275p. Dep. NTIS.

Project Rio Blanco is the first phase of a three-phase program to demonstrate the potential of commercial development of a natural gas field in Colorado by nuclear stimulation methods. This second volume of the three volume Definition Plan describes the tasks needed for the operational scope of work related to the detonation such as: site construction; power installation and distribution; drilling of emplacement well; explosive services and operations including emplacement and stemming; safety requirements; environmental protection and documentation plans; seismic effects documentation; program management; and public affairs and information activities. (L.C.L.)

36035 (USGS-474-120) CHEMICAL AND RADIOCHEMICAL DATA FOR DOMESTIC SUPPLY WELLS AND SURFACE-WATER SAMPLES IN THE VICINITY OF TATUM SALT DOME, LAMAR COUNTY, MISSISSIPPI. Beetem, W. A.; Grove, D. B. (Geological Survey, Denver, Colo.). 1966. Contract AT(29-2)-474. 85p. Dep. NTIS.

Ground-water and surface-water samples collected in the vicinity of Tatum Salt Dome, Mississippi, a U. S. Atomic Energy Commission project test site, were analyzed by the U. S. Geological Survey as part of the evaluation program after the Salmon Event. Samples were collected from wells of all types of construction and at distances of 1 to 5 miles from the dome. (auth)

36036 (USGS-474-124) RADIOCHEMICAL ANALYSES OF GROUND-WATER SAMPLES COLLECTED AFTER THE SALMON EVENT IN THE VICINITY OF TATUM SALT DOME, LAMAR COUNTY, MISSISSIPPI. Beetem, W. A.; Grove, D. B. (Geological Survey, Denver, Colo.). 1966. Contract AT(29-2)-474. 49p. Dep. NTIS.

Ground-water samples have been collected in the vicinity of Tatum Salt Dome, Mississippi, the U. S. Atomic Energy Commission Project Test Site. These samples were collected after the Salmon Event in conjunction with facilities operated by Isotopes, Inc., and Reynolds Electrical and Engineering Co. The 41 samples tabulated herein were analyzed by the U. S. Geological Survey as part of the evaluation program after the Salmon Event. (auth)

36037 ESTIMATING THE FIRING DEPTH OF UNDERGROUND EXPLOSIONS. Douglas, A.; Corbishley, D. J.; Blamey, C.; Marshall, P. D. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). Nature (London); 237: No. 5349, 26-8 (6 May 1972).

The usual way of determining the focal depth of an earthquake is to measure the difference, τ, between the arrival time of the direct P wave and that of the surface reflections pP and sP, the latter representing the signals that travel upward from the focus as P and S waves. This method, however, is difficult to apply for determining the depth of firing of underground explosions using P signals with frequencies $\sim$1 Hz. The value of τ is then small (often 1 sec or less) and recording instrument effects and absorption effects in the Earth's mantle smear out P and pP, so that the two arrivals overlap (sP is not generated by a pure explosion source). A method is described for applying corrections for these effects so that P and pP can be more easily identified as separate pulses and the difference in their arrival times measured. Application of the method to several explosions is demonstrated. The method involves the use of "spiking" filters (Robinson, Geophys. Prospecting, 14: App. 1 (1966)). Some complications are discussed. The most obvious application of the method is to discriminate between earthquake and explosion signals. The method also provides a way of obtaining a rough estimate of the upper limit to the yield of an explosion. (UK)

36038 NUCLEAR EXPLOSIONS APPLIED TO MINING AND CIVIL ENGINEERING. Martinis, B. (Univ., Milan). Geol. Tec.; 18: No. 2, 52-9(1971). (In Italian).

Numerous experiments made especially in the USA and France have verified the usefulness of underground nuclear explosions in the mining industry and in civil engineering. This technique is particularly favorable in stimulating recovery of natural gas and oil from the reservoirs, in underground storing of crude oil, in exploitation of some metallic minerals, and in excavation of cuts for railways, channels, harbors, etc. A detailed knowledge of the geologic features is necessary in all the applications of the nuclear explosives, in order to completely exploit the power produced by the explosion and to avoid any possible damage. The advice of the geologist is also necessary after explosions for the control and estimation of the results on the surrounding rocks. (INIS)

36039 GLOBAL TECTONIC IMPLICATIONS OF ANOMALOUS SEISMIC P TRAVELTIMES FROM THE NUCLEAR EXPLOSION LONGSHOT. Jacob, Klaus H. (Columbia Univ., Palisades, N. Y.). Contracts AT(30-1)-4203; AT(11-1)-3134. J. Geophys. Res.; 77: No. 14, 2556-73(10 May 1972).

A recently developed method of three-dimensional seismic-ray tracing is used to reinterpret P-wave traveltime residuals of the Longshot nuclear explosion on Amchitka, Aleutian Islands, in terms of plate tectonic structures near the source and near the teleseismic stations. The observed pattern of P residuals from Longshot can be explained by a descending lithospheric plate, 80 km thick, that reaches a depth of 250 km beneath the Aleutian arc and has P-wave velocities 7 to 10% higher than the surrounding mantle. The anomalous high velocity at 100- to 200-km depth indicates that the descending plate at that depth is colder than the surrounding normal mantle by several hundred degrees. The P traveltime anomaly associated with the dipping plate is eliminated from the total P residuals to obtain new worldwide station residuals. The station residuals are then grouped according to a proposed tectonic code that distinguishes between active zones of plate convergence, divergence, and transcurrent shear, as well as between volcanically active regions and stable oceanic and continental regions. The tectonically grouped station residuals show a strong correlation with various tectonic features. On the average, P arrivals in continental shields are earlier by 1 sec than in younger (but stable) continental and oceanic provinces, and earlier by 2 sec than in active volcanic regions. The station residuals indicate that lateral velocity anomalies within the upper 200 to 250 km of the earth's mantle are commonly associated with tectonic features and that lateral velocity contrasts may in some cases exceed 10% of the average velocity. A new P-residual map for the United States and adjacent Canada is presented. (auth)

36040 EFFECTS OF NUCLEAR EXPLOSIONS. Dobbelaere, R. (Ministerie van Landsverdediging., Brussels). Ingenieursblad; 41: No. 7, 201-8(1972). (In Dutch).

The possible effects of nuclear weapons on populations are discussed. After a description of the explosion as a phenomenon, the immediate and permanent effects of a nuclear explosion are described. (auth)

36041 MECHANISM OF LOVE-WAVE EXCITATION BY EXPLOSIVE SOURCES. Aki, Keiiti; Tsai, Yi-ben (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 77: No. 8, 1452-75(10 Mar 1972).

Love-wave excitation by large underground nuclear explosions at the Nevada Test Site is uniquely different from that by small explosions at shallow depths in its dependence on shot depth and its change with repeated experiments. There appears to be a magnitude threshold (or depth threshold: the two parameters are correlated) for strong excitation of Love waves from shots in a given geologic area, and the magnitude threshold for Yucca Flat has increased with time during the period from 1962 to 1967. These results support the hypothesis that the tectonic stress release is the major cause of Love waves from the NTS explosions. Two working models of the stress release process are tested against observations. One model is the cavity model, in which pre-existing stress vanishes within a spherical zone around the shot point. The other is the trigger model, in which a fault displacement is triggered outside the immediate vicinity of the shot point. The trigger model was favored because of its better consistency with various observations. Under the assumption of the trigger model, the process was found to be characterized by a low stress drop (around 10 bars), the released energy being comparable to or smaller than the total seismic energy estimated from P-wave magnitude. (auth)

36042 AEC AUTHORIZING LEGISLATION FISCAL YEAR 1973. PART 1. HEARINGS BEFORE THE JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, NINETY-SECOND CONGRESS, SECOND SESSION, ON GENERAL STATEMENT; CIVILIAN APPLICATIONS OF NUCLEAR EXPLOSIVES (PLOWSHARE); NON-NUCLEAR TECHNOLOGY; ISOTOPES DEVELOPMENT; SPACE PROPULSION SYSTEMS; AND SPACE ELECTRIC POWER DEVELOPMENT, JANUARY 26, FEBRUARY 3 AND 17, 1972. Washington, D. C.; Joint Committee on Atomic Energy (1972). 1071p. GPO $4.25.

Protective Structures and Equipment

36043 ENVIRONMENTAL SUIT AND ACCESSORIES (15 Mar 1972) (Engineering Materials). (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). (CAPE-2202).
31 drawings.

A lightweight fully enclosing environmental suit used to completely isolate man from his environment is described. The suit has a self-contained air regulator sensitive to a pressure less than 1/4 in. water gage, and full-flow, self-sealing, quick-detachable air and vacuum connections. The suit is equipped with wiring and plugs for two-way communication. (For details see TID-4100 Suppl. 70) (F.S.)

Safety Engineering

Refer also to abstracts 36309, 36395, and 36564.

36044 (NCRP–40) PROTECTION AGAINST RADIATION FROM BRACHYTHERAPY SOURCES. (National Council on Radiation Protection and Measurements, Washington, D. C.). 1 Mar 1972. 65p. NCRP Publications, Washington, D. C. $2.00.

Information is given for the safe use of sealed radioactive sources in brachytherapy. The recommendations given include those for equipment, facilities, safe methods of clinical application, decontamination, and working conditions. (E.R.B)

Vacuum Engineering

36045 (LBL–769) FEASIBILITY TESTS FOR A LARGE DIAMETER ROTATING VACUUM CHAMBER. Franck, Jack V.; Low, Worley; Schmieder, Robert W. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1972. Contract W-7405-eng-48. 30p. Dep. NTIS.

The initial results of a feasibility study for a large-diameter rotary vacuum chamber with servo controlled angular positioning and readout are described. The design requirements include: pressure in 10^{-6} torr range; vacuum seal diameter greater than 100 cm; rotation rate greater than 1 rpm; and absolute angular readout better than 0.001 radian. Emphasis is placed on minimizing servo power and positioning problems caused by friction in rubbing seals and heavily loaded bearings. A departure from conventional design is presented which makes use of a statically loaded rotating double lid that eliminates the atmospheric loading on the bearings and the use of a ferromagnetic liquid as a vacuum seal. Results of model tests have demonstrated the feasibility of the full size chamber. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

36046 RARE EARTH ELEMENT DISTRIBUTIONS IN EQUATORIAL MID-ATLANTIC RIDGE GABBROS. Schubert, C. E. (Univ. of Miami, Fla.). Nature (London) Phys. Sci.; 237: No. 71, 26-8(8 May 1972).

Samples chosen for evaluation represented end members of tholeiitic and alkali differentiation (Fe, alkali and Mg-rich). The rare earths were chemically isolated and the process monitored with ^{139}Cl and ^{88}Y tracers. After irradiation and chromatographic separation the fractions were gross beta counted in a gas flow proportional counter, and chemical yield and flux corrections applied. Triangular diagrams are shown and discussed that permit simple recognition of differences in large numbers of relative rare earth distribution patterns. It was found that alkali rocks show greater La enrichment than similar non-alkali rocks, and that continental gabbros show a greater La depletion than continental basalts, and the same trend was noted for the oceanic counterparts. The gabbros also showed considerable dispersion in Sm/Yb ratios. La enrichment corresponded to alkali enrichment, Sm enrichment to Fe enrichment, and Yb enrichment to Mg enrichment. The results strongly suggest that the ocean ridge basalts cap a complex characterized by an excess of Eu. The findings are discussed in detail in relation to petrological and stratigraphic considerations. (UK)

36047 URANIUM-BEARING LAYER FROM THE LOWER ORDOVICIAN, SWEDEN. Armands, Goesta (Univ. of Stockholm). Geol. Foren. Stockholm Forh.; 92: No. 543, 481-90 (Dec 1970).

The probable origin of the uranium-bearing sedimentary phosphorite rock in Vaesternorrland County, about 200 km N of the town of Oestersund, is discussed. Subzones 5 a, 5 b and 5 c of the Olenid Series (Upper Cambrian) are exposed at Sjougdälven River. Twenty km to the SE only subzone 5 a is present. The uppermost two subzones, especially 5 c which contains Peltura scarabeoides, are richest in uranium. From a maximum of 200 ppM, the uranium content decreases rapidly downward in the series. The partial destruction of subzones 5 c and 5 b was a result of a regression. This was followed by a transgression during the early Ordovician. Most of the uranium in the radioactive zones is presumed to have originated in subzones 5 c and 5 b. A maximum concentration of about 1,000 ppM uranium was produced in the radioactive Ordovician rock through uranium substitution in phosphorite, a carbonate-fluorapatite. The sedimentary rocks richest in uranium should be sought in the most southeasterly parts of the Lower Ordovician, where the coastal areas of the Upper Cambrian were exposed to erosion and where the overlying Lower Ordovician units are phosphorite bearing. (INIS)

36048 PETROGRAPHIC AND CHEMICAL STUDY OF THE LOWER ORDOVICIAN URANIUM-BEARING SEDIMENTARY UNIT AT TAASJOE LAKE. Andersson, Astrid (Aktiebolaget Atomenergi, Stockholm). Geol. Foren. Stockholm Forh.; 93: No. 544, 117-35(Mar 1971).

A uranium-bearing unit, stratigraphically classified as Lower Ordovician, is included in the border sedimentary sequence of the Swedish Caledonides at Lake Taasjoe, Vaesternorrland County. The parts of the sedimentary rocks rich in uranium are characterized by the mineral association glauconite, calcite, siderite, dolomite, carbonate-fluor-apatite (marine apatite), and quartz. Most of the uranium is localized in the mineral apatite. Investigations of the way in which this mineral occurs in the rocks indicate that the uranium is syngenetic with the deposition of the sediment and the formation of the apatite. (INIS)

36049 URANIUM. Williams, R. M. (Dept. of Energy, Mines, and Resources, Ottawa). Can. Mining J.; 93: No. 2, 113-8(Feb 1972).

World uranium markets softened further in 1971 as continued over-production and intense competition combined to force uranium prices to an all-time low. No Canadian sales were announced. In response to the gloomy short-term outlook, world uranium exploration activity declined almost everywhere except in Australia. By late 1971 the Canadian Atomic Energy Control Board had issued only two new uranium exploration permits, compared with 17 in 1970 and 82 in 1969. Canadian uranium production rose slightly in 1971 to an estimated 4,700 tons of U_3O_8, of which about 4,100 tons were shipped. In response to the growing market for uranium hexafluoride, the first state of the expansion of Eldorado Nuclear refinery was completed. The need for construction of additional uranium enrichment capacity somewhere in the world resulted in a number of proposals and programs during the year. Some encouragement of uranium in the long-term is apparent with a continued surge in nuclear power plant orders. In June, 1971, the Canadian Nuclear Association predicted that requirements of uranium oxide in the world could reach 219,000 tons of U_3O_8 a year by 1990. The level of Canadian uranium production is expected to change little until 1975 when a fourth producer, Gulf Minerals Canada Ltd., will begin production in northern Saskatchewan. At some point toward the end of the decade, however, a shortage of uranium could develop. (Canada)

36050 OCCURRENCE OF SUPERHEAVY NUCLIDES IN NATURE. Zaduban, M. (Safarik Univ., Kosice, Czech.). J. Radioanal. Chem.; 9: No. 2, 293-310(Dec 1971). (In German).

The possibility of the occurrence of superheavy elements in nature is pointed out. The corresponding abundances were obtained by extrapolating the already known abundance values of the elements and their isotopes. According to their expected half-lives, and the spontaneous fission elements 108, 109 and 110 might occur in nature with abundances between 10^{-14} and $10^{-15}\%$, probably in Ru – Rh – Pd and Os – Ir – Pt ores. These elements will be detectable directly by means of activity measurements or indirectly via their fission and decay products. (auth)

36051 SELECTED PAPERS FROM 1970 URANIUM SYMPOSIUM AT SOCORRO, NEW MEXICO, MAY 6–8, 1970. Roman, Ronald J.; Baker, Don H. Jr. (comps.) Circular 118. Socorro, N. Mex.; New Mexico State Bureau of Mines and Mineral Resources (1971). 65p. $1.50. (CONF-700534).

Six articles are included; a separate abstract was prepared for each of four. The remaining articles on the beneficiation and refining of uranium concentrates and production of UF_4 and U metal were previously included in NSA as 24: 51894 and 46210, respectively. (P.C.H.)

For abstracts of individual papers see: 35889 and 36052–36054.

36052 HYDROMETALLURGICAL ASPECTS OF MINERAL EXPLORATION. Matthews, Dale C. pp 1-2 of Selected Papers from 1970 Uranium Symposium. /Roman, Ronald J. (comp.). Socorro, N. Mex.; New Mexico State Bureau of Mines and Mineral Resources (1971).

From American Institute of Mechanical Engineering uranium symposium; Socorro, N. Mex. (6 May 1970).

The term hydrometallurgy is defined as the treatment of minerals by wet processes. However, this term does not eliminate pyrometallurgical applications, but often incorporates heat treatments such as roasting and fusion. The hydrometallurgical process is discussed mostly with regard to uranium deposits. It was concluded that exploration must give due consideration to proposed mining methods in regard to selectivity and/or separation of the ores into metallurgical intervals and provide ample representative samples for the metallurgist to blend and composite to simulate potential mill feeds. Samples of possible contaminating adjacent waste rock and debris should be provided for investigation by the metallurgist to determine such ill effects as slowing of flow, settlement, and/or filtration rates, having a direct influence on process throughput and ultimate uranium production. (P.C.H.)

36053 URANIUM EXPLORATION IN SOUTHWEST TEXAS. Taucher, Leonard M. (Atlantic Richfield Co., New York). pp 3-12 of Selected Papers from 1970 Uranium Symposium. /Roman, Ronald J. (comp.). Socorro, N. Mex.; New Mexico State Bureau of Mines and Mineral Resources (1971).

From American Institute of Mechanical Engineering uranium symposium; Socorro, N. Mex. (6 May 1970).

The results of exploration and development drilling in southwest Texas and the high level of current activity indicate the potential of this area becoming a major uranium producing province. The method of entrapment of uranium deposits in southwest Texas is not fully understood. It is apparent that many accumulations are fault controlled, whereas other appear to be deposited in channel sands. As far as depositional mechanism is concerned, hydrogen sulfide probably played a leading role where it was present in small structures and along faults. Reducing environments created in coaly sedimentary sequence undoubtedly promoted precipitation of uranium, and unquestionably, other parameters also entered the picture. Finally, it is apparent there is a great deal to be learned about southwest Texas uranium deposits. As these deposits become more thoroughly understood, additional reserves will be found, and southwest Texas should take its place beside New Mexico and Wyoming as a major producing region. (auth)

36054 EXPLORATION GEOLOGY METHODS IN THE GRANTS MINERAL BELT. Fitch, David C. pp 13-28 of Selected Papers from 1970 Uranium Symposium. /Roman, Ronald J. (comp.). Socorro, N. Mex.; New Mexico State Bureau of Mines and Mineral Resources (1971).

From American Institute of Mechanical Engineering uranium symposium; Socorro, N. Mex. (6 May 1970).

Uranium exploration methods currently being used in the Grants mineral belt are summarized. Special attention is given to exploration for ore deposits in sandstone in the Morrison Formation. It was concluded that the future potential of the Grants mineral belt to contain large amounts of uranium ore is considered fair to excellent by many geologists. (P.C.H.)

36055 STAGES OF ORE-CONTROLLING STRUCTURE DEVELOPMENT AND CONNECTION OF URANIC ORE FORMATION WITH THEM. Zinchenko, V. A.; Rakovich, F. I. (Inst. of Geochemistry and Minerals of Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 3, 207-10(Mar 1972). (In Ukrainian).

The stages are established in the development of an ore-controlling rupture structure, stage of minerogenesis, and their connection in the process of forming uranic ores. The definite paragenetic association of minerals corresponds to each stage in the development of the rupture structure. The basic mass of the uranic mineralization was formed in connection with the premineral stage of the rupture structure development. (auth)

Radioactive Effluents

Refer also to abstracts 36073, 36092, 36109, 36111, 37842, 37921, 37925, 37950, 37956, 37958, and 37981.

36056 (TID-25978, pp 96-106) CONTRIBUTIONS OF RADIOECOLOGY TO AEC MISSION PROGRAMS. Auerbach, Stanley I. (Oak Ridge National Lab., Tenn.). 1972.

In Ecological aspects of the nuclear age: selected readings in radiation ecology.

The contributions and accomplishments of radioecology in the context of axiology are discussed. Some of the AEC missions in which ecology studies have contributed, include weapons testing, effluents from power reactors and fuel element reprocessing plants, and the Plowshare Project. Another contribution is the application and refinement of systems analysis techniques to the human exposure problem. (P.C.H.)

36057 LOW-LEVEL RADIOACTIVE LIQUID WASTE INTO SURFACE WATERS. van Weers, A. W. (Reactor Centrum Nederland, Petten). Atoomenergie Haar Toepass.; 14: 18-24 (Jan 1972). (In Dutch).

Low-level radioactive liquid waste from nuclear power stations and fuel reprocessing plants is discharged into surface waters. The environmental aspects of these releases, especially with regard to the resulting radiation dose to man, are discussed. The experience obtained so far has shown that the controlled release of radioactivity into surface waters does not give rise to unacceptable radiation exposure of man. Adverse effects on other organisms are also very unlikely. (auth)

Radioactivity Transport and Monitoring

Refer also to abstracts 36056 and 36112.

36058 (MLM-1922) ENVIRONMENTAL MONITORING REPORT: JULY-DECEMBER 1971 AND 1971 SUMMARY. Carfagno, D. G.; Westendorf, W. H. (Mound Lab., Miamisburg, Ohio). 22 May 1972. Contract AT(33-1)-Gen-53. 42p. Dep. NTIS.

The environment surrounding Mound Laboratory was monitored and reported on for the second half of 1971 and for the entire year. Samples analyzed and reported on include air, water, foodstuffs, soil, and silt. For radioactive species the average concentrations of polonium-210, plutoninum-238, and tritium detected were well within the stringent standards adopted by the Atomic Energy Commission and the Environmental Protection Agency. Data concerning non-radioactive species in air and water are presented for the first time. Data for these indicate that Mound Laboratory operations have negligible effects on the environment. (auth)

36059 (ORNL-NSIC-101) INDEXED BIBLIOGRAPHY ON ENVIRONMENTAL MONITORING FOR RADIOACTIVITY. Houser, B. L. (Oak Ridge National Lab., Tenn.). May 1972. Contract W-7405-eng-26. 319p. Dep. NTIS.

Over 850 abstracts on environmental monitoring for radioactivity are divided into six sections: preoperational surveys, surveys at startup, routine surveys during operation, analytical procedures, instrumentation including instrument calibration, and emergency monitoring. These references will provide background information that is necessary for the development of adequate monitoring programs. Important relationships that must be considered are: determination of the critical radionuclides released; the critical pathways to man of these radionuclides; and the critical population groups exposed. (auth)

36060 (SC-M-710913) PROCEEDINGS OF THE SYMPOSIUM ON AIR POLLUTION, TURBULENCE, AND DIFFUSION, DECEMBER 7-10, 1971. Church, H. W.; Luna, R. E. (eds.) (Sandia Labs., Albuquerque, N. Mex.). Mar 1972. 398p. (CONF-711219). Dep. NTIS.

The 51 papers presented at the conference are compiled. The major topics included: air resources management; instrumentation and remote sensing equipment and methods for turbulence, diffusion, temperature distribution, and aerosol content measurements; theory of turbulence and the Boundary Layer I; climatic effects; and diffusion prediction methods. (L.C.L.)

36061 DATA. SECTION IV. OTHER DATA. Radiat. Data Rep.; 13: No. 3, 166-80(Mar 1972).

Data are presented on ^{90}Sr in human bone for January to March 1971 and environmental levels of radioactivity at Atomic Energy Commission installations, including Feed Materials Production Center, Ohio and Savannah River Plant. The results of air sampling at the Feed Materials Production Center indicated that the concentrations at onsite locations averaged 1.0%, 1.0%, and 0.02% of the AEC standards for U, α radioactivity, and β radioactivity. The quantity of radioactive waste released by the Savannah River Plant to its environs was, for the most part, too small to be distinguished from natural background radiation or was obscured by fallout from offsite sources. Beta radioactivity in air, which showed no relation to plant operations and was due to global fallout, was slightly higher than that observed for the same period of 1970 and was a two-fold increase over the previous 6-month period. Radioactive materials in fish flesh continued to be far below levels considered significant from a health standpoint. (P.C.H.)

Atmosphere

36062 (ORO-2529-30) ATMOSPHERIC RADIOCHEMISTRY. Annual Progress Report. Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 30 Apr 1972. Contract AT-(40-1)-2529. 183p. Dep. NTIS.

Fifteen articles are appended; a separate abstract was prepared for each of eight. Five of the articles on daily fluctuations of radioactive fallout particles in ground-level air, radioactive Sr and Ba fallout, temporal distributions of radioactivity and ^{89}Sr/^{90}Sr ratios during rainstorms, worldwide movement of fallout particles from nuclear explosions, and radioactive cerium fallout were previously abstracted in NSA as 25: 29219, 4163, 15791, and 29216 and 26:4430, respectively. The remaining two articles contain information on ^{141}Ce, ^{144}Ce, and ^{141}Ce/^{144}Ce in rain at Fayetteville, Arkansas and ^{140}Ba in ground-level air at Fayetteville (36°N, 94°W) Arkansas. (P.C.H.)

For abstracts of individual sections see: 36063-36070.

36063 (ORO-2529-30, App.VI) RADIOACTIVE PARTICLES IN GROUND LEVEL AIR AT FAYETTEVILLE, ARKANSAS, FROM THE ELEVENTH AND TWELFTH CHINESE NUCLEAR TESTS. Beck, J. N.; Moore, D. T.; Miller, D. K.; Kuroda, P. K. 30 Apr 1972. 12p.

In Atmospheric radiochemistry. Annual progress report.

Autoradiographs were taken on individual air filters collected at Fayetteville, Arkansas, after the eleventh and twelfth Chinese nuclear tests. No particles were found in ground-level air after the eleventh Chinese test, however, the largest single concentration of fallout particles measured at Fayetteville was observed after the twelfth Chinese test. Immediately after the first arrival of debris particle concentration decreased rapidly and thus the debris from the twelfth Chinese test was interpreted to be injected entirely in the troposphere. Radiochemical and γ-ray analysis of the air filters are now proceeding at this time. (auth)

36064 (ORO-2529-30, App.VII) RECENT INJECTIONS OF RADIOACTIVE STRONTIUM AND CERIUM ISOTOPES INTO THE ATMOSPHERE BY NUCLEAR TESTING. Noyce, J. R.; Moore, D. T.; Sherwood, J. D.; Daniel, P. R.; Beck, J. N.; Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 30 Apr 1972. 23p.

In Atmospheric radiochemistry. Annual progress report.

Three Chinese thermonuclear weapon tests were the major sources of nuclear debris in the Northern Hemisphere from late 1968 through mid-1970. Isotopic ratios of debris from these tests varied with time in a similar manner. Contributions from United States tests in Nevada to the variation of the ^{89}Sr/^{90}Sr ratio, but not the ^{141}Ce/^{144}Ce ratio, were observed twice during this time. Radioactive debris was detected from a French nuclear test series conducted in the Southern Hemisphere during the summer months of 1970. Interhemispheric transit times were between one and two months. French debris may have crossed the equator via Hadley Cell circulation. (auth)

36065 (ORO-2529-30, App.VIII) MASS YIELD DISTRIBUTION OF MIXED FISSION PRODUCTS IN RAIN FROM CHINESE AND FRENCH DEBRIS. Moore, D. T.; Daniel, P. R.; Noyce, J. R.; Sherwood, J. D.; Beck, J. N.; Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 30 Apr 1972. 9p.

In Atmospheric radiochemistry. Annual progress report.

Measurements of 14 fission products in a sample of rain collected at Fayetteville, Arkansas, on October 2, 1971, yielded 3 "mass-yield" curves; one for fresh debris from the French nuclear tests, one for debris from the previous Chinese test in the Northern Hemisphere and one for older debris. The first curve resembled the mass-yield curve for ^{239}Pu, the second and third for ^{235}U. An estimate of the contribution to the observed fallout in the October 2, 1971 rain from French testing is given. (auth)

36066 (ORO-2529-30, App.IX) BEHAVIOR OF RADIOSTRONTIUM IN RAIN AND AIR AFTER THE NINTH CHINESE ATMOSPHERIC NUCLEAR TEST: PRECIPITATION SCAVENGING. Noyce, J. R.; Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 30 Apr 1972. 40p.

In Atmospheric radiochemistry. Annual progress report.

^{89}Sr and ^{90}Sr were measured in rainwater and air at Fayetteville, Arkansas, for nine months after the ninth Chinese atmospheric nuclear test. ^{89}Sr/^{90}Sr activity ratios showed behavior very similar to what was observed after the eighth Chinese atmospheric test. Ratios of ^{89}Sr activity in rains to activity in air samples were computed, and like-wise for ^{90}Sr. These precipitation scavenging (PS) ratios were found to vary widely, but those for ^{89}Sr tended to be higher than those for ^{90}Sr. They did not have any well-defined relation with time, amount of rainfall, or number of meteorological parameters. The data indicate a consistent relationship between fallout and rainfall may be necessary for PS ratios to be meaningful and useful on a short-term basis. (auth)

36067 (ORO-2529-30, App.X) RADIOACTIVE CESIUM FALLOUT. Daniel, P. R.; Sumerlin, N.; Moore, D. T.; Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 30 Apr 1972. 9p.

In Atmospheric radiochemistry. Annual progress report.

A six year summary of radiocesium data compiled during the past six years was compared with ^{90}Sr data from the same period. The difference in fallout rates after individual nuclear detonations and in the stratospheric mean residence times is explained on the basis of relative volatility of the mass chain producing these two nuclides. The influence of the series of Chinese nuclear tests on the long-term observed concentrations of ^{137}Cs and ^{90}Sr is discussed. (auth)

36068 (ORO-2529-30, App.XI) RADIOACTIVE CERIUM ISOTOPES: THE FALLOUT FROM RECENT FRENCH AND CHINESE NUCLEAR WEAPONS TESTS. Sherwood, J. D.; Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 30 Apr 1972. 10p.

In Atmospheric radiochemistry. Annual progress report.

A new method involving gamma spectroscopy was used to determine the ^{141}Ce/^{144}Ce ratios in individual samples of rain and snow collected at Fayetteville, Arkansas (36°5′N, 94°9′W). By the use of a Ge(Li) detector, the counting period for the cerium samples can now be shortened from over 8 months to only one day. The presence was noted of fresh nuclear debris in the Northern tropospheric rain from the French nuclear weapons tests conducted in the Southern Hemisphere during the summer months of 1970, followed by the appearance of the fresh Chinese debris after October 1970. (auth)

36069 (ORO-2529-30, App.XII) CALCULATION OF MEAN RESIDENCE TIMES OF TROPOSPHERIC AEROSOLS BASED ON MEASUREMENTS OF RaDEF IN RAINWATER. Nevissi, A.; Beck, J. N.; Kuroda, P. K. 30 Apr 1972. 12p.

In Atmospheric radiochemistry. Annual progress report.

Residence times were calculated from the measurements of ^{210}Bi/^{210}Pb and ^{210}Po/^{210}Pb activity ratios in rainwater collected at Fayetteville, Arkansas. Data were obtained on thirteen rains that fell during the period of April 18, 1971, and July 29, 1971. Residence times calculated based on ^{210}Bi/^{210}Pb ratios varied from 10 to 60 days while those based on the ^{210}Po/^{210}Pb activity ratio varied from 12 to 125 days. (auth)

36070 (ORO-2529-30, App.XIII) RECENT INJECTIONS OF RADIOACTIVE STRONTIUM DUE TO NUCLEAR TESTING. Daniel, P. R.; Moore, D. T. 30 Apr 1972. 9p.

In Atmospheric radiochemistry. Annual progress report.

A brief summary of ^{89}Sr, ^{90}Sr, and ^{89}Sr/^{90}Sr ratio data on rain and snow at Fayetteville, Arkansas collected during the period August 1970 to December 1971 is presented. (auth)

36071 DATA. SECTION III. AIR AND DEPOSITION. Radiat. Data Rep.; 13: No. 3, 153-65(Mar 1972).

Data are presented on gross β radioactivity in surface air and precipitation for Nov. 1971, Canadian gross β radioactivity in surface air and precipitation for Nov. 1971, gross β radioactivity in Pan American surface air for Nov. 1971, gross β radioactivity in California air for Nov. 1971, Pu in airborne particulates for April through June 1971, and gross β radioactivity concentrations in air in the U.S. for Aug. and Sept. 1971. (P.C.H.)

36072 DATA. SECTION III. AIR AND DEPOSITION. Radiat. Data Rep.; 13: No. 4, 215-26(Apr 1972).

Data are presented on gross β radioactivity in surface air and precipitation for Dec. 1971, Canadian gross β radioactivity in surface air and precipitation for Dec. 1971, gross β radioactivity in South American surface air, Dec. 1971, gross β radioactivity in California air for Dec. 1971, Pu in airborne particulates for July through Sept. 1971, and gross β radioactivity concentrations in air in the U. S. for Oct. and Nov. 1971. (P.C.H.)

36073 ASSESSMENT OF AIRBORNE PARTICLES. FUNDAMENTALS, APPLICATIONS, AND IMPLICATIONS TO INHALATION TOXICITY. Proceedings Publication of the Third International Conference on Environmental Toxicity, Rochester, New York, June 18-20, 1970. Mercer, Thomas T.; Morrow, Paul E.; Stoeber, Werner (eds.). Springfield, Ill.; Charles C Thomas, Publisher (1972). 554p. $32.75. (CONF-700665).

Twenty-seven articles are included; a separate abstract was prepared for each of three. The remaining articles contain information on aerosols under the following session headings: aerosol fundamentals, aerosol production and measurement, size analysis and shape factors, disposition of inhaled aerosols, and assessment of hazardous aerosols. (P.C.H.)

For abstracts of individual chapters see: 36074, 36075, and 36463.

36074 SHAPE FACTORS FOR AEROSOLS OF COAL, UO_2, AND ThO_2 IN RESPIRABLE SIZE RANGE. Kotrappa, P. (Univ. of Rochester, N. Y.). pp 331-58 of Assessment of Airborne Particles. Fundamentals, Applications, and Implications to Inhalation Toxicity. /Mercer, Thomas T. (ed.). Springfield, Ill.; Charles C Thomas, Publisher (1972). (UR-49-1338).

From third international conference on environmental toxicity; Rochester, N. Y. (18 Jun 1970).

Aerodynamic diameters in the range from 0.3 μm to 5 μm have been determined for particles of a low-grade coal, pulverized UO_2, and ThO_2, using a recently developed spiral centrifuge aerosol spectrometer. Volume shape factors, dynamic shape factors, ratios of projected area diameter to Stokes' diameter, and projected area diameter resistance shape factors were determined and the functional relationships between shape factors and projected area diameter were established. Surface shape factors, averaged over the entire size range, were also determined. The shape factor relating projected area diameter to Stokes' diameter for UO_2 was found to be useful in revising calibration curves for respirable mass samples (cyclones) and cascade impactors which were originally calibrated using uranium oxide aerosol. Use of the Hatch and Choate equation for calculating mass median diameters from the number distribution was examined, as was the procedure of fitting a suitable spheroid model to satisfy the shape factors. (auth)

36075 AEROSOL SAMPLING FOR INHALATION HAZARD EVALUATIONS. Lippmann, Morton (New York Univ., N. Y.). pp 449-64 of Assessment of Airborne Particles. Fundamentals, Applications, and Implications to Inhalation Toxicity. /Mercer, Thomas T. (ed.). Springfield, Ill.; Charles C Thomas, Publisher (1972).

From third international conference on environmental toxicity; Rochester, N. Y. (18 Jun 1970).

Realistic evaluation of the potential hazard arising from the inhalation of airborne particles requires knowledge of the regional deposition of the particles, and sampling techniques which are capable of providing reliable estimates of regional deposition. A multistage aerosol sampler capable of collecting samples over extended intervals and providing size-mass distribution data has been developed and calibrated for aerosols in the 1 μm to 10 μm aerodynamic diameter range. It consists of an array of six parallel two-stage cyclone-filter combinations sampling from a common inlet tube. The collection characteristics of the individual cyclone samplers in this array were compared to the deposition characteristics of respiratory tract regions in man. These comparisons were made for regional deposition measurements made at N.Y.U. Institute of Environmental Medicine on normal nonsmoking human males for the following regions and combinations of regions: the head during mouth breathing, the head during nasal breathing, the tracheobronchial region, and the combined head plus tracheobronchial regions for both mouth and nasal breathing. It was found that each of the five regions and combinations of regions can be closely simulated by a cyclone sampling at an appropriate rate. Thus, the multicyclone sampler can be used to obtain samples of the particles which deposit in specific functional regions of the human respiratory tract. The very large range of normal regional deposition as a function of particle size makes it difficult to establish a "standard man" for regional deposition in order to select the appropriate sampling rates for the cyclones. The applicability of the sampling technique described may be severely limited until the requisite criteria are established by a widely recognized professional organization. (auth)

Soil

Refer also to abstracts 36023 and 37721.

36076 (CEA-R-4304) ^{106}Ru DISTRIBUTION IN A REDUCED MODEL SIMULATING RIVER-BANKS; SOME HYDRODYNAMIC AND KINETIC ASPECTS OF ITS ADSORPTION ON SEDIMENTS. Lachet, Bernard; Gagnaire, Janine; Plebin, Roger (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr 1972. 28p. (In French). Dep. NTIS (U. S. Sales Only).

Study of the behavior of nitrato-nitrosyl ^{106}Ru introduced into the aqueous medium of a reduced model (245 × 110 × 100 cm) to simulate a river bank, has confirmed the orders of magnitude obtained both for concentration factors of this element in aquatic plants, and for its weak upward mobility in aerial parts of semiaquatic plants. On the other hand, after crossing into the bank, the complex undergoes transformation, and, as a result, passes up into the aerial organs of Salix purpurea, Populus nigra, and Phragmites communis. The effects of hydrodynamic conditions on the adsorption of ^{106}Ru in Isère sediments have been studied in columns (ϕ = 30 cm; h = 2 m): rinsing with uncontaminated water partially displaced the radio-element; at constant concentration of contamination it was accumulated on the surface. The flow used was as closely as possible the downwards flow to the natural underground water-level. Finally, kinetic properties of a water purification by sediments in suspension can be interpreted as a function of time by an equation of the form $(\mathrm{Ru}) = (\mathrm{Ru})_0 (1 + t/a)^n$ where "a" and "n" are two parameters fixed by the "least-squares" method. (auth)

36077 (ORNL-4720, pp 1-10) FATE OF TRACE ELEMENTS AND RADIONUCLIDES IN TERRESTRIAL ENVIRONMENT. Tamura, Tsuneo; Bonner, W. P.; Francis, C. W.; Brinkley, F. S.; Eastwood, E. R.; Perhac, R. M. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

CENTRIFUGATION—method of zonal, for separation of minerals in sediments
CESIUM-137—distribution in White Oak Lake silts, (E)
CLAYS—analysis for minerals in, x-ray diffraction method for
COBALT-60—distribution in White Oak Lake silts, (E)
MERCURY-203—content in sediments and water in contact with sediments, (E)
METALS—content of dissolved- and particulate-phase heavy, in Cherokee Reservoir water, (E)
MINERALS—separation of sediment-contained, zonal centrifugation method for
—identification of clay-contained, x-ray diffraction analysis method for
SILTS—separation of minerals from, use of zonal centrifugation for
—radioisotope distribution in White Oak Lake, measurement of cesium-137 and cobalt-60
—mercury-203 content of, in contact with mercury-203-containing water, (E)
SURFACE WATERS—heavy element content of Cherokee Reservoir, measurement of dissolved- and particulate-phase
WATER—mercury-203 content of, in contact with silts, (E)
X-RAY DIFFRACTION ANALYSIS—use for identifying minerals in clays, (E) (L.C.L.)

36078 STUDIES ON ENVIRONMENTAL CONTAMINATION BY URANIUM. II. ADSORPTION OF URANIUM ON SOIL AND ITS DESORPTION. Masuda, Kuniyoshi: Yamamoto, Takashi (Hygienic Lab. of Okayama Prefecture, Japan). J. Radiat. Res.; 12: No. 3-4, 94-9(Sep-Dec 1971).

Experimental studies on the behavior of uranium on soils were carried out using three kinds of soil; volcanic ash, alluvial, and sandy soils. The results showed that uranium dissolved in water (1 to 100 μg as U/ml) was almost completely adsorbed on every soil examined. The desorption of uranium from soil with salt solutions was extremely difficult especially from volcanic ash soil. (auth)

36079 INFLUENCE OF PLANT EXTRACTS ON THE MOBILITY OF ^{59}Fe AND ^{60}Co IN SOIL UNDER CONDITIONS OF DYNAMIC LABORATORY EXPERIMENTS. Chebotina, M. Ya. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 756-9(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 740-4(Sep-Oct 1971).

Under the conditions of dynamic laboratory experiments, plant extracts (aqueous extracts from pine needles, linden and aspen leaves) increase the content of ^{59}Fe and ^{60}Co in the filtrate of soil columns in comparison with the control (lake water). The content of ^{59}Fe in column filtrates increases with increasing number of volumes of the solution passed through (in all the experimental variations). The content of ^{60}Co in the filtrate in the control is practically constant; in the variation with an extract from pine needles it increases with increasing number of volumes of the solution passed through, while in the variation with extracts from linden and aspen leaves it at first increases, but then remains practically constant. The mobilizing action of the extracts in general increases in the series: lake water < extract from pine needles < extract from linden leaves < extract from aspen leaves. In the variation with extracts, radioactive cobalt is uniformly distributed through the soil filter; in the control it is basically sorbed by the first soil layer. The content of iron-59 in all the experimental variations more or less uniformly drops along the layers of the soil filter. (auth)

Water

36080 (BNWL-1649) RADIOLOGICAL STATUS OF THE GROUNDWATER BENEATH THE HANFORD PROJECT, JANUARY-JUNE 1971. Kipp, K. L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash.). Apr 1972. Contract AT(45-1)-1830. 28p. Dep. NTIS.

Data collected during the first six months of 1971 to provide an evaluation of the status of ground water contamination resulting from disposal of Hanford plant effluents are presented. Three hundred wells were monitored for ^{3}H, ^{106}Ru, and the nitrate ion (NO_3^-). The ^{106}Ru–Rh and ^{3}H concentrations measured near the surface of the unconfined groundwater during the first half of 1971 showed that zones of detectable contamination extended in an easterly to southeasterly direction from 200-E Area as has been observed in the past. Measurable ^{3}H and NO_3^- concentrations were found along the Columbia River in the vicinity of the 100 Areas. A low groundwater mound showing uranium and nitrate ion continued to be observed in the 300 Area. The few locations for which average groundwater concentrations exceeded the Concentration Guide (CG) for ^{106}Ru–Rh were all within either 200-E or 200-W Areas with the exception of Well 299-E26-7 which monitors the 216-A-24 crib. Total beta activity concentrations in the groundwater beneath the 100 areas were detectable only at 100-N Area, as a result of continued discharges to the 100-N trench. Concentrations of ^{3}H greater than the Concentration Guide were found in Wells 699-35-70 (outside the southeast corner of 200-W Area) and 299-E-26-7 (east of the 200-E Area). Nitrate ion concentrations greater than 10% of the Public Health Service (PHS) recommended drinking water standard of 45 ppM were observed in most groundwater samples from wells within and surrounding the 200 and 300 Areas. However, groundwater from these zones is not consumed by humans or animals. For the first time, extensive routine nitrate measurements were made within and surrounding the 100 Areas. These measurements showed large zones north of Gable Mountain in which nitrate concentrations were greater than 10% of the PHS recommended drinking water standard. There are no major changes in other isopleth contours since the previous report period (July to Dec. 1970). The minor adjustments which have been made are mostly due to results from newly sampled wells. Although water samples from several wells with piezometer tubes extending to deep aquifers were obtained and analyzed during this report period, all such samples had gross beta concentrations less than the analytical limit (0.16 pCi/ml). (auth)

36081 (EUR-4768) CRITICAL STUDY OF THE MAXIMUM PERMISSIBLE CONCENTRATION OF ^{226}Ra IN WATER IN THE PRESENCE OF SULFATE IONS. Koch, G.; Boulenger, R.; Weyers, C.; Gerard, A.; Verhoeven, F.; Baton, J. (European Communities, Brussels (Belgium). Commission. Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium)). Mar 1972. 61p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 85,-.

Should radium, in terms of health physics, be considered as "soluble" or "insoluble" in water where the calcium and sulfate content may be high enough to cause precipitation of calcium sulphate? Preliminary physicochemical experiments have revealed a low rate of radium entrainment by the calcium sulfate precipitate. In the presence of barium this entrainment rate is higher, but the decontamination factor is still far below the ratio between the MPCs of "soluble" and "insoluble" radium. Biological assays have been carried out on mice to determine the rate of incorporation of radium sulfate administered by stomach intubation, both in pure water and in the presence of dissolved or suspended calcium sulfate. These assays lead to the conclusion that in the case under consideration, radium must be regarded as "soluble". (auth)

36082 (RLO-2225-T-20-5) RADIOCARBON IN THE SEA. Progress Report, May 1, 1971-May 1, 1972. Fairhall, A. W. (Washington Univ., Seattle. Dept. of Chemistry). 1972. Contract AT(45-1)-2225. 30p. Dep. NTIS.

Experimental studies were continued to determine the fate of ^{14}C which was introduced into the atmosphere by nuclear testing in the 1950's and 1960's by measuring the ^{14}C content of seawater samples collected at varying depths in the southern oceans, North Pacific, and North Atlantic. Also a program was begun to collect, analyze, chemically fractionate, and hopefully to measure the ^{14}C specific activity of sea foam. The results of laboratory measurements made during May 1971 to May 1972 of the ^{14}C content in seawater samples are presented. (L.C.L.)

36083 (USGS-474-119) RADIOCHEMICAL ANALYSES OF GROUND-WATER AND SURFACE-WATER SAMPLES COLLECTED AFTER THE SALMON EVENT IN THE VICINITY OF TATUM SALT DOME, LAMAR COUNTY, MISSISSIPPI. Beetem, W. A.; Grove, D. B. (Geological Survey, Denver, Colo.). 1966. Contract AT-(29-2)-474. 77p. Dep. NTIS.

Samples of ground water and surface water were collected in the vicinity of Tatum salt dome, Mississippi, the U.S. Atomic Energy Commission Project Test Site. These samples were collected in conjunction with facilities operated by Isotopes, Inc., and Reynolds Electrical & Engineering Co. or from the streams of the area. The samples tabulated herein were analyzed by the U.S. Geological Survey as part of the Salmon Event evaluation program. (auth)

36084 DATA. SECTION II. WATER. Radiat. Data Rep.; 13: No. 3, 141-52(Mar 1972).

Data are given on gross radioactivity in surface waters of the U.S. for July 1971, the Colorado River Basin for 1968, and Washington state for July 1969 through June 1970. Radium-226 concentrations at all stations of the Colorado River Basin except one continued to average well below recommended maximum concentrations. Of the 50 river water samples analyzed in Washington State (excluding the Columbia River), the total β radioactivity ranged from <1 to 12 pCi/1. Monthly average total β radioactivity for the Columbia River stations below the Hanford facility ranged from 2 to 373 pCi/1. Monthly average concentrations of the β emitter ^{32}P ranged from <1 to 85 pCi/1. Monthly averages for ^{51}Cr ranged from <100 to 2,362 pCi/1, and for ^{65}Zn the range was <20 to 194 pCi/1. (P.C.H.)

36085 DISTRIBUTION OF ^{137}Cs AND NATURALLY OCCURRING RADIONUCLIDES IN SEDIMENTS OF LAKE MICHIGAN. Plato, Philip A. (Univ. of Michigan, Ann Arbor). Radiat. Data Rep.; 13: No. 4, 181-7(Apr 1972).

Measurements of radioactivity in bottom sediments of Lake Michigan were made during 1969 and 1970. The only man-made radionuclide found was cesium-137 which originated from over two decades of atmospheric testing of nuclear weapons. A correlation was observed between accumulation of cesium-137 in sediments and water current patterns in Lake Michigan. Concentrations of naturally-occurring potassium-40 and radium-226 were found to correlate with the type of sediment present. (auth)

36086 RADIOACTIVITY LEVELS IN SELECTED OHIO STREAMS; THE GREAT MIAMI RIVER, THE LITTLE MIAMI RIVER, AND MILL CREEK; JUNE-AUGUST 1968. (Environmental Protection Agency, Cincinnati). Radiat. Data Rep.; 13: No. 4, 189-94(Apr 1972).

A water quality study of the Little Miami River, Great Miami River, and Mill Creek was conducted by the Office of Water Programs, U. S. Environmental Protection Agency. Analyses were performed for uranium, radium-226, lead-210, thorium, and strontium-90. Uranium concentrations in the Little Miami River, Great Miami River, and Mill Creek averaged 0.4, 0.9, and 0.3 μg/liter, respectively. Radium-226 concentrations averaged 0.08, 0.11, and 0.04 pCi/liter, respectively. Strontium-90 concentrations averaged 0.7, 0.4, and 1.1 pCi/liter, respectively. The average thorium concentration was less than 3 μg/liter in all three streams. Lead-210 averaged less than 0.2 pCi/liter in the Little and Great Miami Rivers and 0.7 pCi/liter in Mill Creek. (auth)

36087 BALANCES OF ^{90}Sr AND ^{137}Cs IN THE BALTIC SEA. Voipio, A. (Inst. of Marine Research, Helsinki); Salo, A. Nord. Hydrol.; 2: No. 1, 57-63(1971).

The total amount of ^{90}Sr and ^{137}Cs that accumulated in the water of the Baltic Sea in the years 1960 to 1967 were estimated on the basis of 10 to 15 samples collected annually in different parts of the Baltic Sea. The changes found in the amounts were compared with evaluated effects of decreasing and increasing processes. (auth)

36088 MEAN CONTENTS OF TRACE ELEMENTS IN THE BOTTOM SEDIMENTS OF THE BLACK SEA. Babinets, A. E.; Mitropol'skii, O. Yu. (Inst. of Geological Sciences, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 3, 258-60(Mar 1972). (In Ukrainian).

The distribution of the background contents of trace elements in the Black Sea sediments is non-uniform and depends mainly on the form of transport of one or another element by rivers, on the ratio between suspended and soluble components, and on the manner of location of the elements in the granulometric spectrum of suspensions. The elements transported as suspensions in coarse-pellite and silt fractions gives coastal borders of maxima separated by the pelagic strip of minimum. If the suspensions transported as a fine-pellite fraction as well as when the content of the soluble component increases, the shift in concentrations of the elements to the pelagic zone is observed. The mean contents of 16 trace elements are calculated in recent Black Sea sediments, old Black Sea, and new euxine ones. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 36454, 36460, and 36464.

36089 (BMI-171-142) FRESHWATER VERTEBRATE AND INVERTEBRATE ECOLOGY OF AMCHITKA ISLAND. Amchitka Bioenvironmental Program. Annual Progress Report, July 1, 1970-June 30, 1971. Neuhold, J. M.; Helm, W. T.; Valdez, R. A. (Utah State Univ., Logan (USA). Coll. of Natural Resources). Dec 1971. Contract AT(26-1)-171. 25p. Dep. NTIS.

For Battelle Columbus Labs., Ohio.

An extensive survey of Amchita's streams reveals that small late August spawning runs of pink salmon occur in 13 streams with total annual output of fry to the marine environment estimated at 67,730. Annual contribution of coho smolts from three major stream systems is about 1,600. No significant numbers of other species of salmon occur on the Island proper. Populations of pink salmon and Dolly Varden in one stream show a trend toward recovery since abatement of pollution in summer, 1969, and Milrow in October, 1969. Coho salmon previously found in the stream, however, were absent. (auth)

36090 (CISE-E-817) CONTRIBUTION OF CISE TO RADIOECOLOGICAL RESEARCH. Triulzi, Cesare (Centro Informazioni Studi Esperienze, Milan (Italy)). [nd]. 6p. (In Italian). (CONF-701146-1). Dep. NTIS (U. S. Sales Only).

From first Conference on the state of advancement of radioecology in Italy; Parma, Italy (5 Nov 1970).

The research activity of the CISE in radioecology can be divided into the following: analysis of primary samples from ambient radioactive contamination, analysis of fluvial samples, analysis of marine samples, and laboratory studies in support of the other three. A bibliography of 31 references in these areas is appended. (J.S.R.)

36091 (RLO-2225-T-14-3) STUDIES OF THE NATURAL ALPHA-EMITTING RADIOISOTOPES IN MARINE ORGANISMS. Annual Progress Report, 1971-1972. Schell, W. R. (Washington Univ., Seattle. Lab. of Radiation Ecology). 1 May 1972. Contract AT(45-1)-2225. 23p. Dep. NTIS.

Research directed toward determining the levels of radionuclides in marine organisms which serve as a source of these radionuclides in man's diet is described. The main source of ^{210}Pb and ^{210}Po is natural decay products of radium. These radioisotopes may reach the marine organisms by four pathways: by fallout or rain-out of precipitation from airborne particles and gases from the troposphere; by erosion and redistribution of marine materials by tidal action; by sediment transport from rivers; and by leaching of radium from sediments. To follow the radionuclides from their source to man, samples were obtained from the following components of the environment: atmosphere; water; plankton; crustaceans; pelagic fishes; benthic fishes; and intertidal organisms. The work accomplished during 1971 included: computer programming for calculation of ^{210}Pb and ^{210}Po; continuation of the systematic sampling program for biota, water, and sediments; and analysis of several hundred samples for ^{210}Pb and ^{210}Po. Tabulated data from preliminary calculations of ^{210}Pb and ^{210}Po in samples collected from fresh and salt water areas near Seattle, Wash. are included. (L.C.L.)

36092 (TID–25978) ECOLOGICAL ASPECTS OF THE NUCLEAR AGE: SELECTED READINGS IN RADIATION ECOLOGY. Schultz, Vincent (Washington State Univ., Pullman. Dept. of Zoology); Whicker, F. Ward (Colorado State Univ., Fort Collins. Dept. of Radiology and Radiation Biology). 1972. 588p. Dep. NTIS.

Fifty-three articles are included; a separate abstract was prepared for each of seven. Two articles, Radioactivity in the Sea: General Classification of Radionuclides, and Radioactivity in the Sea: Effects on Fisheries, were published in The Encyclopedia of Marine Resources. The remaining 44 articles containing information on: scope, status, and needs of radiation ecology; radionuclide cycling; ionizing radiation effects; ecological techniques utilizing ionizing radiation; and nuclear war, waste disposal, and peaceful uses of nuclear energy were previously published in NSA as 12: 16882; 16: 5150 and 12934; 17: 21424, 21506, 33540, 33592, and 33594; 19: 1998, 10733, and 12858; 20: 1588, 2080, 2081, 6714, 12570, 12573, 12584, 12586, 12662, 12981, and 45266; 21: 18016, 20115, 28342, 39168, and 41476; 22: 51487; 23: 11658, 17967, 17984, 18005, 22300, 22317, 29480, and 50586; 24: 9806, 12038, 33217, 34203, 39473, and 41794; and 25: 12763 and 24073. (P.C.H.)

For abstracts of individual papers see: 36056, 36093–36095, and 36100–36102.

36093 (TID–25978, pp 12-29) SPECIES RESPONSE TO RADIATION; RADIOECOLOGY. Buchsbaum, Ralph (Pittsburgh Univ., Pa.). 1972.

In Ecological aspects of the nuclear age: selected readings in radiation ecology.

Discussion is presented on the effects of radiations on species of plants and animals in natural communities, or ecosystems (rather than in laboratory-controlled situations) under various levels of radiation, and the progress that has been made in specific ecological studies in communities under radiation stress. From the results of the study it was concluded that atomic catastrophe, through blast, fire, and lethal-level radiation, will kill large numbers of plants and animals, producing bare areas that are open to erosion, and will be followed by pioneer stages of ecological succession. What type of climax will finally result will depend upon the climate, the extinction of endemic species, and the production of novel mutants, first from existing pioneer types and later from types that invade from adjacent areas. Long-time increases in levels of radiation would facilitate extinction of small populations and rare species of limited range, and would increase the rate of evolution through the production of novel mutants arising out of competition with those presently more dominant. A possible consequence is the evolution of more radioresistant types. (P.C.H.)

36094 (TID–25978, pp 183-94) SYSTEMS ANALYSIS OF ^{134}Cs KINETICS IN TERRESTRIAL MICROCOSMS. Patten, Bernard C.; Witkamp, Martin (Oak Ridge National Lab., Tenn.). 1972.

In Ecological aspects of the nuclear age: selected readings in radiation ecology.

Laboratory experiments were conducted to determine patterns and rates of ^{134}Cs exchange in microecosystems composed of different combinations of radioactive leaf litter, soil, microflora, millipedes, and aqueous leachate. Rate constants were determined by fitting models to data with an analog computer. Simulations with the models permitted comparisons of different microcosms in terms of time to radiocesium equilibrium, steady state concentrations, concentration factors, input and output fluxes, turnover rates, and stability. Rate constants varied with different compartment combinations, indicating both qualitative and quantitative differences in the cesium exchange patterns within different systems. This result is generalized: transfers of energy and matter in ecosystems are functions of networks which define intercompartmental interactions; internal coupling should be considered a significant variable in investigations of ecosystem processes. Points of particular interest derived from the computer simulations are: organism concentration factors for a material may vary in different systems, depending upon how the organism is coupled to other compartments; total flux of a material in a steady state system may vary considerably from that in another system which receives identical input; material turnover within compartments and in the system as a whole tends to increase as more compartments are added; and stability of material concentration does not appear to increase with system complexity. (auth)

36095 (TID–25978, pp 218-24) REGULARITIES OF UPTAKE AND ACCUMULATION OF RADIONUCLIDES IN AQUATIC ORGANISMS. Polikarpov, G. G. (Inst. of Biology of South Seas, Sevastopol, USSR). 1972.

In Ecological aspects of the nuclear age: selected readings in radiation ecology.

Initial notions and fundamental elements of radioecology, including dependence of uptake and accumulation processes on physicochemical state of radionuclide, pH, temperature, and light; kinetic features of radionuclide uptake and accumulation; dependence of processes of uptake and accumulation on concentration of chemical elements; ways of entry of radionuclides into aquatic animals; and uptake and accumulation of radionuclides in biogeographical and biocenological aspects are discussed. (P.C.H.)

36096 DATA. SECTION I. MILK AND FOOD. Radiat. Data Rep.; 13: No. 3, 131-40(Mar 1972).

Surveillance results are given for ^{90}Sr and ^{137}Cs for November 1971 and the 12-month period, December 1970 to November 1971. ^{90}Sr monthly averages ranged from 0 to 25 pCi/l in the U.S. for November 1971, and the highest 12-month average was 17 pCi/l (Duluth, Little Falls, Minn.), representing 8.5% of the Federal Radiation Council radiation protection guide. ^{137}Cs monthly averages ranged from 0 to 70 pCi/l in the U.S. for November 1971, and the highest 12-month average was 54 pCi/l (Southeast Florida), representing 1.5% of the value derived from the recommendations given by the Federal Radiation Council. Data are also given for ^{89}Sr, ^{131}I, and ^{140}Ba in milk for November 1971. (P.C.H.)

36097 DATA. SECTION I. MILK AND FOOD. Radiat. Data Rep.; 13: No. 4, 195-207(Apr 1972).

Surveillance results are given for ^{90}Sr and ^{137}Cs for December 1971 and the 12-month period, Jan. 1971 to Dec. 1971. ^{90}Sr monthly averages ranged from 0 to 24 pCi/l in the U. S. for Dec. 1971, and the highest 12-month average was 19 pCi/l at Minneapolis, Minn., representing 9.5% of the Fed. Radiation Council radiation protection guide. Cesium-137 monthly averages ranged from 0 to 49 pCi/l in the U. S. for Dec. 1971, and the highest 12-month average was 54 pCi/l (Central Florida), representing 1.5% of the value derived from the recommendations given by the Fed. Radiation Council report. Data are also given for ^{131}I, and ^{89}Sr in milk for 14 different laboratories located in the U. S. for Dec. 1971. (P.C.H.)

36098 DATA. SECTION II. WATER. Radiat. Data Rep.; 13: No. 4, 208-14(Apr 1972).

Data are given on gross radioactivity in surface waters of the U.S. for Aug. 1971, ^{90}Sr in tap water for Jan. through June 1971, and the Tritium Surveillance System for surface waters and tap water for July through Sept. 1971. A decreasing trend has been observed in the ^{90}Sr concentrations in tap water in New York City since the July 1963 peak. The maximum ^{90}Sr concentrations observed were below the acceptable limit as set forth in the interstate carrier drinking water standards. The average tritium concentration in drinking water at the Radiation Alert Network (RAN) stations covering the U.S., including Alaska and Hawaii for July through Sept. 1971 was 0.2 nCi/l. The highest individual concentration of tritium observed in drinking water was 1.5 nCi/l. This corresponds to a dose of 0.3 mrem/a, or less than 0.2% of the Fed. Radiation Council's Radiation Protection Guide (170 mrem/a) for an average dose to a suitable sample of the exposed population. The highest tritium concentration for surface water samples was 3.9 nCi/l. This concentration corresponds to a dose of 0.6 mrem/a, or 0.4% of the Radiation Protection Guide. Data are tabulated. (P.C.H.)

Radiometric Techniques

Refer also to abstracts 36092, 37752, and 37963.

36099 (RLO–2225-T-18-2) STUDIES OF CONCENTRATIONS OF UNREPORTED LONG-LIVED RADIONUCLIDES IN BIOTA AND

OCEAN SEDIMENTS AT BIKINI AND ENIWETOK ATOLLS. Annual Progress Report, 1971–1972. Schell, W. R. (Washington Univ., Seattle. Lab. of Radiation Ecology). 1 May 1972. Contract AT(45-1)-2225. 12p. Dep. NTIS.

The present research is directed toward measuring the long-lived radionuclides which were produced by the U. S. testing program at Bikini and Eniwetok Atolls. These radionuclides have been distributed both locally and worldwide from injections into the troposphere and stratosphere and subsequent meteorological transport; they have been distributed in the marine environment by transport away from the atolls by ocean currents and have reached the marine environment by fallout from the stratosphere. These radionuclides can serve as tracers for meteorological and oceanographic processes. Many of the long-lived radionuclides can serve as tracers of natural processes. The long-time history of naturally-occurring and cosmic ray-produced radionuclides may have been disturbed by the recent nuclear testing. It is essential to measure the bomb-produced radionuclides which have been produced so that scientists using the long-lived natural radionuclides can be aware of potential problems in interpreting results applied to geochemical processes. The work accomplished during 1971 included: completing the multiparameter gamma ray spectrometer and preparing computer programs to read out the 64 × 64 matrix; and developing chemical procedures for separating the several long-lived radionuclides in Bravo crater samples from the 1967 collection. Preliminary results show the presence of ^{10}Be and ^{55}Fe. Other radionuclides are being prepared for counting. (auth)

36100 (TID–25978, pp 396-419) UTILIZATION OF RADIOISOTOPES IN FORESTRY RESEARCH. Fraser, D. A. (Petawawa Forest Experiment Station, Chalk River (Ontario)); Gaertner, E. E. 1972.

In Ecological aspects of the nuclear age: selected readings in radiation ecology.

The use of radioisotopes in several aspects of forestry, including forest products, tree physiology, forest ecology, forest soils, tree breeding, forest entomology and pathology is discussed. (207 references) (P.C.H.)

36101 (TID–25978, pp 420-8) USE OF RADIOISOTOPES IN HYDROBIOLOGY AND FISH CULTURE. Hooper, F. F. (Michigan Dept. of Conservation, Ann Arbor (USA)); Podoliak, H. A.; Snieszko, S. F. 1972.

In Ecological aspects of the nuclear age: selected readings in radiation ecology.

The use of radioisotopes has increased rapidly in hydrobiology and fish culture. Their use, especially ^{32}P, to study circulation of nutrients has been demonstrated and offers opportunities in problems of lake metabolism. The most extensive use of isotopes has been to determine photosynthetic activity in plankton through ^{14}C uptake. Applications and limitations are discussed. Isotopes have been successfully used in food studies of fish to determine food selection, metabolism, and storage. Water movements in fresh and salt water and in sewage problems have been successfully followed by use of various isotopes. Marking of aquatic animals with radioisotopes has many possible applications, but has been little used because of some inherent problems related to danger to organisms and in field use. Extent of future use of isotopes in hydrobiology will be determined by further study of hazards and public acceptance of field studies. (auth)

36102 (TID–25978, pp 444-60) USE OF TRACER TECHNIQUES FOR THE STUDY OF BIOGEOCHEMICAL CYCLES. Olson, J. S. (Oak Ridge National Lab., Tenn.). 1972.

In Ecological aspects of the nuclear age: selected readings in radiation ecology.

The use of radioisotope tracers in studies on biogeochemical transfer in trees and forests is discussed. The topics covered include: transfer model; elemental cycles— small, medium, and large; tree-tagging methods; Oak Ridge results on trees; model evaluation; and role of tracers in the international biological program. Examples of tracer studies are given that show that they are only preliminary hints of the broad role of isotopes in evaluating the hazards of pollution and also in basic ecological research. (P.C.H.)

36103 INFLUENCE OF MOISTURE CONTENT ON ANALYSIS OF ORE SAMPLES BY GAMMA–GAMMA METHODS IN REFLECTION GEOMETRY. Timofeev, E. V. Vop. Razved. Geofiz.; No. 11, 78-81(1969). (In Russian).

The effect of moisture on results on assay by the gamma-gamma method was ascertained by conducting measurements both on wet slime samples directly at the borehole and on dried samples of slime under laboratory conditions. Results showed that the influence of moisture on the test data was increased with an increase in the moisture or by a reduction of the Fe content in the sample. The presence of moisture thus produced a change in the effective atomic number in the sample, and altered the results of the gamma-gamma method. (K.S.W.)

36104 LATE CRETACEOUS AGE BASED ON K/Ar DATES OF GRANITIC ROCK FROM THE TAMBELAN AND BUNGURAN ISLANDS, SUNDA SHELF, INDONESIA. Haile, N. S. (Univ. of Malaya, Kuala Lumpur); Bignell J. D. Geol. Mijnbouw; 50: No. 5, 687-90(Sep-Oct 1971).

K/Ar determination on two adamellites from the Tambelan and Bunguran Islands, on the Sunda Shelf between the Malay Peninsula and Borneo, indicate that these are pre-Tertiary, probably Late Cretaceous. Rb/Sr determinations on the rock from Bunguran Island, and a third granitic rock from Tambelan Island, are not definitive, but are consistent with a Late Cretaceous age for the intrusion of the granitic rocks. These determinations, the first age indications from the Tambelan and Bunguran Islands, throw doubt on the supposed "pre-Upper Triassic" age of the acid batholiths in the Anambas Zone of the Sunda Shelf and its extension into West-Borneo. (auth)

36105 NEON ISOTOPES IN RADIOACTIVE MINERALS. Sharif-Zade, V. B.; Shukolyukov, Yu. A.; Gerling, E. K.; Ashkinadze, G. Sh. (Inst. of Geology and Geochronology, Leningrad). Geokhimiya; No. 3, 314-22(Mar 1972). (In Russian).

The hypotheses of isotope fractionation during diffusion and generation of ^{21}Ne and ^{22}Ne by cosmic muons inadequately explain the ^{21}Ne and ^{22}Ne excess in minerals and natural gases. The elaborated methods allowed neon to be separated from helium on the basis of their different coefficients of diffusion through a heated membrane of fused quartz. The isotopic analysis was carried out on a MV-2302 mass-spectrometer with a resolving power of about 5000. The neon losses by minerals calculated with the aid of data on the loss of radiogenic helium, krypton, and xenon by the same minerals. Between the ^{21}Ne amounts calculated in assumption of the ^{18}O reaction (α,n) and the experimentally found ones a correlation is observed, which evidences in favor of this nuclear reaction as a ^{21}Ne source. The mechanism of ^{22}Ne formation is not completely clear. (auth)

36106 URANIUM-SERIES DATING OF BONE FROM THE ISIMILA PREHISTORIC SITE, TANZANIA. Howell, F. C. (Univ. of California, Berkeley); Cole, G. H.; Kleindienst, M. R.; Szabo, B. J.; Oakley, K. P. Nature (London); 237: No. 5349, 51-2(5 May 1972).

Reference is made to an earlier dating of these fossil bones by the uranium-series method, assuming an ideal closed system with respect to U and daughter elements. It has since been reported, however, that some of the dated bones showed evidence of U migration, and hence measurements of both ^{230}Th/^{234}U and ^{231}Pa/^{235}U activity ratios were required for reliable dating. Results are given for these ratios, together with the calculated ^{230}Th and ^{231}Pa ages. These results indicated that the specimen was undisturbed during at least the past 170,000 years. The ^{230}Th age of the bone was calculated as $260{,}000^{+70{,}000}_{-40{,}000}$ years, while the ^{231}Pa age was >170,000 years. (UK)

36107 OPTIMUM PROBE LENGTH IN A RADIOMETRIC DENSITY METER WITH A SCINTILLATION INDICATOR. Zvol'skii, S. T. (Inst. of Geological Sciences, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 3, 224-6(Mar 1972). (In Ukrainian).

On the basis of experimental research in basic operating characteristics of preinverse and transinverse probes in radiometric density meters with scintillation indicator of NaI(Tl) type and dimensions of 30 × 40 mm, it was established that in engineering and geological researches of soil density, the transinverse probes should predominate. Optimum probe length was 14 to 16 cm in case of using ^{137}Cs and about 20 cm with ^{60}Co sources of γ-irradiation. (auth)

Site Surveys

Refer also to abstracts 36134, 36641, and 36642.

36108 (DOCKET-701257-2) MIXED OXIDE FUEL PLANT. Applicant's Supplemental Environmental Report. (Jersey Nuclear Co., Richland, Wash.). 12 Apr 1972. 164p. (JN-14(Add.2)). Dep. NTIS.

The environmental impact of the mixed oxide (Pu) operations at Jersey Nuclear's Richland fuel fabrication facility are reported. An attempt was made to make it open-ended so that it covers, from an environmental impact standpoint, operating levels and scope that are beyond those currently licensed by the AEC for the Jersey Nuclear Mixed Oxide Fuel Facility. The topics discussed include: the site; the plant; environmental effects of site preparation and construction; environmental effects of plant operation; environmental effects of accidents; unavoidable adverse effects of plant operation; alternatives to plant operation; long-term effects of plant operation; irreversible and irretrievable commitments of resources; benefit-cost analysis; and environmental approvals and considerations. (P.C.H.)

36109 (WASH–1506) PLUTONIUM FACILITY, LOS ALAMOS SCIENTIFIC LABORATORY, NEW MEXICO. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Jan 1972. 101p. Dep. NTIS.

The environmental statement concerns the design and construction of a new plutonium facility at LASL. Existing facilities no longer required for Pu work will be decontaminated for other uses or demolished. The new facility will incorporate improved features which include decreased probability of accidental release of radioactive materials and increased operating safety. (J.R.D.)

36110 (WASH–1512) ROVER FUELS PROCESSING FACILITY, NATIONAL REACTOR TESTING STATION, IDAHO. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Apr 1972. 188p. Dep. NTIS.

The environmental impact of constructing and operating a Rover Fuels Processing Facility was studied. The proposed project would consist of modifying a small portion of the existing Idaho Chemical Processing Plant (ICPP) at the National Reactor Testing Station (NRTS) in Idaho to store and subsequently reclaim usable U from the Rover fuels. This fuel contains 2600 kg of highly enriched U (93% ^{235}U). Approximately \$26 million worth of U could be removed for reuse at a cost of about \$4.5 million. The environmental costs associated with this project will be the temporary use of less than one acre of land at the NRTS site for an indefinite period of time and the release of small quantities of radioactive fission products at very low concentrations. The facility will be designed to minimize the quantities of radioactive and nonradioactive discharges released, and the effluent cleanup systems will be designed to comply with state and federal regulations on pollution control. Because large quantities of Rover fuels exist, the fuel must either be stored or processed. Consideration of these alternatives indicated processing would result in net environmental as well as economic benefits. It is concluded that the proposed Rover Fuels Processing Facility should be constructed. (L.C.L.)

36111 (WASH–1520) CONTAMINATED SOIL REMOVAL FACILITY, RICHLAND, WASHINGTON. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Apr 1972. 87p. Dep. NTIS.

Liquid wastes from the Plutonium Finishing Plant (PFP) at Richland, Wash. have been discharged to subsurface disposal facilities (enclosed trenches) since the startup of the facility approximately 22 years ago. It is proposed to construct and operate a Contaminated Soil Removal Facility near the Z-9 trench to permit excavation and packaging of contaminated soil, to add equipment to the existing PFP to permit recovery of Pu from the contaminated soil, and to construct an underground storage vault 14 ft wide by 8 ft high by 400 ft long for interim storage of contaminated soil. The environmental impact of constructing and operating the proposed Contaminated Soil Removal Facility was studied. Data are presented on the probable, extraordinary adverse, and unavoidable adverse environmental effects of this facility, the irreversible and irretrievable commitments of resources, and a cost-benefit analysis. Two alternatives to the proposed facility are considered. After assessing and balancing the benefits to be obtained from removing Pu-contaminated soil from the Z-9 enclosed trench against the environmental and economic costs, and after considering the range of alternatives and their environmental impact, the AEC concluded that the proposed action should be undertaken. (L.C.L.)

36112 (WASH–1520(Dr.)) CONTAMINATED SOIL REMOVAL FACILITY, RICHLAND, WASHINGTON. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Jan 1972. 55p. Dep. NTIS.

The environmental impact of removing approximately 1800 ft^3 of plutonium-contaminated soil from the floor of the Z-9 enclosed trench which was used from July 1955 to June 1962 as a subsurface disposal facility for liquid wastes from the Plutonium Finishing Plant near Richland, Wash. is discussed. It is estimated that 100 kg of Pu are contained in the soil to be removed and that three-quarters of this Pu can be extracted economically. Residues from the extraction and the Pu-depleted soil would be packaged in plastic bags, placed in steel drums, and stored underground. Information is included on the probable, unavoidable, and extraordinary adverse environmental effects; alternatives; commitments of resources; and cost analysis. It is concluded that the benefits to be obtained from removing the Z-9 enclosed trench soil exceed the environmental and economic costs, and that the proposed excavation should be undertaken. (Three appendixes on the Hanford Plant Environment, seismic activity at the Hanford area, and the Radiochemical Reprocessing Facilities are included.) (L.C.L.)

36113 (WASH–1522) ^{238}Pu FUEL FABRICATION FACILITY, SAVANNAH RIVER PLANT, SOUTH CAROLINA. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Apr 1972. 81p. Dep. NTIS.

Information is presented in support of the legislative authorization and appropriation for the construction, principally within an existing building, of facilities for converting ^{238}PuO$_2$ into compactea shapes for use, as fuel in radioisotope thermoelectric generators. The principal environmental protection feature of the proposed project is an extensive exhaust filtration system designed to minimize the release of radioactivity. There is expected to be an unavoidable release of ^{238}Pu that would be less than $^{1}/_{100}$ of one percent. A description, evaluation of anticipated benefits, characterization of the existing environment, evaluation of probable environmental effects and extraordinary adverse environmental effects, a discussion of alternatives, evaluation of relation between short-term uses and long-term productivity, and a cost-benefit analysis are presented. (M.C.G.)

Thermal Effluents

Refer also to abstracts 37842, 37921, 37925, 37942, 37950, 37951, 37956, 37958, and 37981.

36114 (CONF-711031) WASTE HEAT UTILIZATION. Proceedings of the National Conference, October 27–29, 1971, Gatlinburg, Tennessee. Yarosh, Marvin M. (ed.) (Oak Ridge National Lab., Tenn.). May 1972. 354p. Dep. NTIS.

Twenty three papers were presented at the conference. A separate abstract was prepared for each. (M.C.G.)

For abstracts of individual papers see: 36115–36137.

36115 (CONF-711031–, pp 7-18) POWER IN THE SYSTEM. Warren, Frederick H. (Federal Power Commission, Washington, D. C. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

Guidelines on growing public interests in waste heat in energy production and use are discussed. Systems and electric conversions that may evolve from the two most abundant future resources (coal and nuclear energy) are considered. (M.C.G.)

36116 (CONF-711031–, pp 21-38) USE OF WASTE HEAT IN AGRICULTURE. Jensen, Merle H. (Arizona Univ., Tucson). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

The feasibility of using warm water from steam power plants in agriculture as a means of enhancing an environment for crop production within, or outside, a greenhouse unit is considered. Yields of vegetables grown in greenhouse environments where warm water is used have been extremely high when compared to the same crops grown outdoors. While outdoor environments can be altered for agricultural purposes by warm water, the environment is still subject to seasonal changes, but in greenhouses these changes are mostly eliminated. As a result, crops can be grown in a greenhouse year-round which accounts for yields being so much greater than outdoor production. Feasibility studies show that, if high yields from greenhouses are realized, the extra production would offset the cost of the growing unit. One of the major costs in greenhouse production is heating. Using waste heat from a power plant may be an alternative heat source. (auth)

36117 (CONF-711031–, pp 39-66) THERMAL AQUACULTURE: POTENTIAL AND PROBLEMS. Yee, William C. (Oak Ridge National Lab., Tenn.). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

Thermal aquaculture is a method for using heated effluents productively, but it does not significantly reduce the heat disposal problem of the power plant. Basic data show that warm-water fish growth rates could be increased by a factor of 2 to 3 by controlling the temperature of the water medium within the range of 75 to 85°F. Yield potential can be optimized in flowing stream aquaculture employing nutritionally balanced feed and oxygenation of the water. Food conversion efficiency also improves with temperature control. The short-term impact of this activity on power plant siting should be small. Over the longer term, however, the possibilities for aquaculture should be considered during site selection. Site-oriented demonstration programs are needed to provide technical data that will indicate the extent of improvement in quality and yield of culturable fish species through greater environmental control. Thermal aquaculture will not diminish the amount of waste heat to be rejected from a power plant. During the summer, it may be desirable or necessary to dilute the heated discharge water with ambient temperature water. During the winter, the water temperature at many sites may not be as warm as desired. Unless it is removed from the culture stream effluent, fish waste could contribute to the pollution of the receiving water by increasing the biological oxygen demand. The cost of adding a treatment plant to take care of fish wastes, particularly in the effluent of an intensive culture facility, should be considered and evaluated as part of the economics of thermal aquaculture. (auth)

36118 (CONF-711031–, pp 67-76) URBAN USE OF THERMAL ENERGY FROM STEAM-ELECTRIC PLANTS. Miller, A. J. (Oak Ridge National Lab., Tenn.). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

The removal of live steam from the turbine of a steam–electric plant at low temperature after it has generated considerable electricity, and subsequent beneficial use of its thermal energy, results in an increase in the efficiency of fuel energy utilization. The use of such low-temperature heat conserves fuel, keeps down air pollution and lessens the release of waste heat. There is potential for consumption of very large quantities of this heat in an urban area for applications such as industrial processes, building space heating, domestic hot water, heating, air conditioning, and the melting of snow and ice. There might also be application in the fields of water recycle and transportation vehicles. Waste heat from the condenser cooling water could be used in agriculture and aquaculture installations in an urban area. A preliminary study showed that under several sets of circumstances the use of low-temperature and waste heat was feasible in a hypothetical new, large freestanding city. Much more planning and coordination would be required than now employed in the development of a new city or redevelopment of a large urban area. (auth)

36119 (CONF-711031–, pp 77-82) USE OF INDUSTRIAL PROCESS STEAM TO REDUCE NUCLEAR PLANT WASTE HEAT. Kessler, William E. (Consumers Power Co., Jackson, Mich.). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

The Midland Nuclear Plant delivers industrial process steam to the Dow Chemical Company. With the coincidence of Dow's need for energy in the mid-70's to replace increasingly noneconomic self-supplied fossil fuel energy systems and Consumers Power Company's electrical load growth in the Midland-Bay City-Saginaw area, a joint endeavor to meet both needs seemed a natural one. Not only would Dow be able to offset the trend in energy costs but the condensing of the equivalent to about 250 Mw(e) would be accomplished by the cascading of the process steam through the multitude of manufacturing process at Dow prior to its return to the Nuclear Plant as condensate, thus eliminating that amount of waste heat load from the environment. The cooling pond, "essentially-zero" rad-waste system, and reboiler system for isolation of process steam from potential radioactivity are some of the features of this joint venture by Consumers Power Company and Dow Chemical. (auth)

36120 (CONF-711031–, pp 92-124) LEGAL RULES GOVERNING CONSUMPTIVE AND NONCONSUMPTIVE USE OF WATER IN THE EASTERN UNITED STATES; RELATIONSHIP TO WATER POLLUTION, INCLUDING THERMAL POLLUTION; STATE AND FEDERAL COMMON LAW AND STATUTORY CONTROLS; SEA WATER; AQUACULTURE AND THE LAW. Maloney, Frank E. (Florida Univ., Gainsville). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

Early Eastern water law was based on the natural flow doctrine, which gave preference to non-consumptive over consumptive use of water, protected power generation by milldams, and provided a legal basis for pollution control. A gradual switch to the reasonable use doctrine provided for consumptive use, but weakened the legal basis for pollution control. Consumptive use under either rule was limited to riparian owners. State law at first provided the only legal controls over water pollution. Today the Federal Water Quality Act provides additional legal controls. The National Environmental Policy Act creates added problems with respect to dissipation of thermal energy by water cooling. With respect to seawater, consumptive use is not likely to present serious problems in the foreseeable future, but pollution, including thermal, has become recognized as a large and growing problem. Use of excess thermal energy for mariculture may conflict with rapidly developing regulation of marine pollution. Florida's aquaculture law is discussed as a solid legal basis for mariculture. Its provisions for leasing the marine water column may run afoul of private riparian rights and public rights of navigation, as well as pollution control laws. (M.C.G.)

36121 (CONF-711031–, pp 125-37) LEGAL PROBLEMS IN WASTE HEAT UTILIZATION IN APPROPRIATION STATES. Moses, Raphael J. (Platte River Municipal Power Association, Boulder, Colo. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

Waste heat utilization to avoid thermal pollution is considered. Legal restrictions on secondary or enlarged uses of water rights in appropriation states, designed to maintain conditions on the stream as they were when junior rights were acquired, may present such enlarged use. These restrictions are examined, exceptions to them are noted, and a solution to the problem offered. The California method of correlating water right applications with pollution control measures is recounted. (auth)

36122 (CONF-711031–, pp 138-43) CONFLICTS IN UTILIZATION OF HEATED WATER EFFLUENTS FROM POWER PLANTS IN MARICULTURE. Wallace, David H. (National Oceanic and Atmospheric Administration, Washington, D. C. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

More and more power plants are being located adjacent to major bodies of salt water. The changes brought about in the environment by the addition of 15 to 25°F to the water has become a critical issue in the preservation of the marine environment as a suitable habitat for the organisms living in the waters in which the heated water is discharged. Warm water is needed for a number of species in developing closed system mariculture. For example, oysters cease growing in the colder natural waters of Eastern United States for about four months of the year. Furthermore, spawning is erratic in the summer since the natural waters do not warm up sufficiently in some years to trigger the release of the eggs and sperms. The use of heated water effluents from fossil-fuel and possibly nuclear plants in mariculture is a way in which the increase heat load can be used for beneficial purposes. It would seem possible that systems could be designed and engineered in such a way as to provide for mariculture and still meet the environmental concerns. (auth)

36123 (CONF-711031–, pp 144-55) WATER QUALITY STANDARDS: IMPACT ON WASTE HEAT. Nalesnik, Richard P. (Environmental Protection Agency, Washington, D. C. (USA). Div. of Water Quality Standards). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

The Federal water quality standards program is based on the 1965 Water Quality Standards Act, part of the fundamental environmental law, the Federal Water Pollution Control Act. The program comprises a beneficial interstate water use category, scientifically determined water quality criteria to protect beneficial uses, and implementation and enforcement plans. A nondegradation provision protects existing high quality waters. The Environmental Protection Agency's Water Quality Standards Division uses as its basic guide the National Technical Advisory Committee report, Water Quality Criteria, now being updated by the National Academy of Sciences. NTAC reported scientific investigations of adverse environmental effects from waste heat discharges. Various effective thermal pollution control techniques exist for the electric power producers and research, development, and demonstration programs are being carried out to expand environmental control knowledge. Thermal programs include biological and engineering studies. The Refuse Act Permit Program is wholly Federal and controls industrial effluent discharges to navigable and tributary waters. (M.C.G.)

36124 (CONF-711031–, pp 166-85) THERMAL WATER DEMONSTRATION PROJECT. Price, Byron L. (Eugene Water and Electric Board, Oreg. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

To develop multiple uses for water, particularly after it is polluted by industrial heating, the Thermal Water Horticultural Demonstration Project was begun. The first purpose was to determine if there were detrimental effects from 120-degree thermal water used in cooling a pulp and paper manufacturing process and then sprayed on crops. The second was to determine whether thermal water sprayed over the tops of fruit and nut trees, and other row crops, such as corn and beans, could: prevent frost damage, and thus eliminate smudge pots and the burning of auto tires;

prevent sunburning by creating high humidity; increase yields; hasten yields, and permit double-cropping. In all cases results were favorable. (M.C.G.)

36125 (CONF-711031–, pp 186-92) GROWING OF MARINE ANIMALS (ESPECIALLY OYSTERS AND CLAMS) ON A COMMERCIAL SCALE USING HEATED SEAWATER EFFLUENT. Vanderborgh, George H. Jr. (Long Island Oyster Farms, Inc., Northport, N. Y. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

A brief history of oyster culture and the market in the New York area is given. The system used in culture is briefly described. A detailed picture of the biology and life cycle of the oyster is presented including the breeding, spawning, hatchery activities, and predator problems. The techniques used and methods of harvesting as employed by the Long Island Oyster Farms are described. (auth)

36126 (CONF-711031–, pp 193-209) TVA PROGRAMS: WASTE HEAT UTILIZATION IN GREENHOUSES AND OTHER AGRICULTURALLY RELATED PROJECTS. Williams, Gerald G. (Tennessee Valley Authority, Muscle Shoals, Ala.). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

TVA has set aside 180 acres within the exclusion area of Browns Ferry Nuclear Plant near Athens, Alabama, for research and development in ways of utilizing heated water. The temperature of the condenser water will have a rise of about 27°. Proposed research and demonstration activities include: (1) heating and cooling greenhouses for horticultural crop production, (2) environmental control for livestock and poultry housing, (3) subsoil heating to extend the growing season, (4) recycling nutrients from livestock wastes, and (5) aquacultural production based on data obtained from a research and development catfish production project at the TVA Gallatin Steam Plant. During 1972, a prototype greenhouse will be constructed to further test heating and cooling mechanisms designed by ORNL and also obtain production information for a number of horticultural crops. Investigations thus far by TVA for waste heat utilization include: (1) greenhouse construction costs, (2) heating and cooling cost with conventional as well as waste heat methods, (3) possible crops for greenhouse production, (4) effects of large-scale greenhouse crop production upon existing marketing conditions, and (5) effects of subsurface heating and subsurface irrigation on yields of horticultural crops. (auth)

36127 (CONF-711031–, pp 210-24) THERMAL ENERGY AND THE 21st CENTURY CITY. Piland, V. M. (Great Northern Corp., Tulsa, Okla. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

The development of a prototype controlled environment city, called Sewards' Success, on the banks of the Cook Inlet near Anchorage, Alaska is discussed. Use of thermal energy in this development is considered. (M.C.G.)

36128 (CONF-711031–, pp 225-31) MARINE AQUACULTURE AT CRYSTAL RIVER, FLORIDA. Watts, W. R. Jr. (Florida Power Corp., St. Petersburg). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

A number of demonstration projects dealing with waste heat utilization were initiated to prove the feasibility of technology. The approach of Florida Power Corporation and the Ralston Purina Company in the organization and initiation of the Crystal River mariculture project is described. The planning results show that it is possible to design a venture for long-term economic success as well as research and development. In designing the venture, an initial assumption was made that both companies must be technically and economically active in the project to insure its success. Contributions of both parties during the research phase as well as any resulting commercial venture were carefully described prior to proceeding. It is believed that technical advances permitting the use of waste heat in mariculture and other applications will become available in the near term. Management, legal, and economic systems must be developed to permit these advances to be utilized as quickly and as effectively as possible. (auth)

36129 (CONF-711031–, pp 240-9) SEAFOOD MARKETING AND ECONOMICS. Atchison, Richard C. (Ralston Purina Co., St. Louis, Mo. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

By investigating the relationships of several seafood categories, some of which have been subject to controlled supply (i.e., mariculture) and some of which are sourced by traditional methods, the stabilizing effect of the flexible production ability is shown. The effects of the proposed utilization of waste heat as related to mariculture and the marketing of seafood products, especially tuna and shrimp, are discussed with relationships presented in a somewhat quantified manner. (M.C.G.)

36130 (CONF-711031–, pp 250-61) COMMERCIAL PRODUCTION AND MARKETING OF CROPS GROWN HYDROPONICALLY IN ENVIRONMENTALLY CONTROLLED GREENHOUSES. Lentz, Malcolm L. (Hydroculture, Inc., Glendale, Ariz. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

In studies of the use of waste heat in the greenhouses, costs of heating and cooling should be related to pounds of production for proper comparisons. Factors to be considered in assessing feasibility of large growing complexes near power plant sites include hours of sunshine at the site, transportation to markets, location of living accommodations for employees and financing. Cooperative projects should be studied with a view to the rapid advances that can be expected in controlled environment agriculture. (auth)

36131 (CONF-711031–, pp 263-7) THERMAL ENRICHMENT: PROBLEMS AND POTENTIAL. Vanderborgh, George H. Jr. (Long Island Oyster Farms, Inc., Northport, N. Y. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

A brief review of the history of the Long Island Oyster Farms and the regulations of New York State governing allowable temperatures to be discharged to receiving water bodies is presented. Meetings with State and Federal agencies on the Northport Operation are reviewed. The background events as seen by the Long Island Oyster Company, which has led to the present situation, are presented. (auth)

36132 (CONF-711031–, pp 268-75) REGULATING THERMAL EFFLUENT IN NEW YORK STATE. Jensen, Albert C. (New York State Dept. of Environmental Conservation, Ronkonkomo (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

New York State classifies its waters, fresh and marine, according to their highest and best usage with standards and criteria that define degree and kind of pollutants. Discharges of heated liquids are now regulated by the standards. The State encourages the beneficial use of the thermal effluents but the highest and best use of the waters take priority. (auth)

36133 (CONF-711031–, pp 276-84) AGENCIES AND THERMAL DISCHARGES. Doebler, Henry M. (Long Island Lighting Co., Mineola, N. Y.). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

Since 1965, the Long Island Lighting Company along with the Long Island Oyster Farms and Inmont Corporation have engaged in a venture to cultivate oysters in the discharge lagoon of the Northport Power Station. New York State and Federal agencies involved with the thermal discharges have followed this development since its inception. A discharge design compatible with State estuarine criteria included a dilution system that would keep lagoon temperatures between 50 and 90°F on a year-round basis. In August 1970, the State, reclassified the Long Island Sound waters at Northport, coastal. This made the dilution system inadequate and necessitated a diffuser pipe design that would extend at least one mile into the Sound. (M.C.G.)

36134 (CONF-711031–, pp 298-301) POWER PLANT SITING AND THE USE OF HEAT. Yarosh, Marvin M. (Oak Ridge National Lab., Tenn.). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

The effective use of waste heat and low temperature heat will require prior and early consideration during the process of selecting sites for steam power plants. Utilities should include on their agenda of site requirements the site potential for heat use. Although presently recognized uses of heat may represent only a small fraction of the available heat, the thermal energy use over the next 30 years can be equivalent to electric energy production today. Low cost heat may represent an added incentive to the local population for accepting a power plant nearby. Heat utilization can be a progressive force in influencing the location and development of new cities and improving the posture of national energy use. (auth)

36135 (CONF-711031–, pp 302-8) STATEMENT FOR WASTE HEAT UTILIZATION CONFERENCE. Weinhold, J. Frederick (Office of Science and Technology, Washington, D. C.). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

Two principal incentives for using waste heat are: the hope that by such use its adverse effects in the environment may be reduced; and heat use may permit a reduction in the total raw energy consumed, and thereby reduce environmental impact. The use of waste heat (low-temperature heat) has the maximum potential for service in space heating and in industrial process use. The demands in these sectors account for nearly 35% of the total energy consumption, a very significant potential market for heat. The selective energy system, a small onsite system, may provide a means for integrating small total energy systems into the present electrical power grid. Such systems would generate electrical power and use the waste heat discharge in onsite applications. When waste heat is not required, and electrical grid loads are not at peak, the system would be inoperative and electrical power would be drawn from the grid. (auth)

36136 (CONF-711031–, pp 309-16) REGULATORY TREATMENT OF PROJECTS FOR BENEFICIAL USES OF WASTE HEAT. Lindsay, William W. (Federal Power Commission, Washington, D. C. (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

Problems concerning the regulatory treatment of projects for beneficial uses of waste heat include: (1) the treatment of R & D expenditures relating to beneficial uses of waste heat, and (2) the rate treatment of expenditures and revenues, if any, related to projects in being. There have been relatively few projects initiated to date which use waste heat from electric power generating stations for beneficial purposes. Consequently, the regulatory problems relating to projects of this sort are primarily concerned with the treatment that might be accorded such projects if initiated rather than the treatment being accorded projects actually in being. Consideration of these questions involves review of the various types of projects in which utilities may dispose of waste heat for beneficial purposes. (M.C.G.)

36137 (CONF-711031–, pp 317-24) STATE UTILITY REGULATORY PERSPECTIVES ON BY-PRODUCT HEAT. Smith, Don S. (Arkansas Public Service Commission, Little Rock (USA)). May 1972.

From National conference on waste heat utilization; Gatlinburg, TN. (27 Oct 1971).

A strong trend by State Commissions towards encouraging research and development expenditures by utilities to reduce the environmental impact of producing electric power is observed. Changes in accounting procedures by the Federal Power Commission and by many State Commissions are encouraging such expenditures. Similar procedures applied to the productive use of waste heat may stimulate the research required to encourage sufficient investigation of heat utilization. (M.C.G.)

36138 WASTE HEAT DISPOSAL IN POWER PLANTS. Jimeson, R. M.; Adkins, G. G. (Federal Power Commission, Washington, D. C.). Chem. Eng. Progr.; 67: No. 7, 64-9(Jul 1971).

Even though forces exist in the nation that recommend reduced production of electric power as a means of environmental control, the power industry is challenged to provide adequate and reliable power within rational environmental requirements. The demand for electric power is expected to increase by a factor of four in the next 20 years. For power plants equipped with adequate protection of the aquatic environment, the consumptive use of fresh water will increase seven to tenfold. As many as 140, and possibly as many as 300, new plants will require cooling towers, and from 50 to 130 new plants may require cooling ponds by the year 1990. The annualized cost to the power industry for control of the water environment is estimated to range from \$1.3 to \$2 billion/yr., and the industry must raise an additional \$6 to \$9 billion in the capital market in the next 20 years to achieve control of thermal pollution. Much research leading to improved environmental controls is yet needed. Also, additional emphasis should be placed on research leading to more efficient power generation, since successful development would have a major impact on reducing environmental degradation. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 36661, 36692, and 37975.

36139 (AWRE-O–22/72) WIDE-ANGLE GAMMA-RAY PIN HOLE CAMERA. Bennett, W. E. (Atomic Weapons Research Establishment, Aldermaston (England)). Apr 1972. 20p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

A gamma-ray pin hole camera is described which has a 90° field of view and is capable of recording the radiation from weakly emitting surfaces in the presence of other sources of highly penetrating radiation. This has particular reference to the radiation scattering conditions in the vicinity of a 6 to 15 MeV linear accelerator. (auth)

36140 (CEA-R–4298) UTILIZATION OF A dE/dx, E TELESCOPE TO IDENTIFY CHARGED PARTICLES WITH ENERGIES LESS THAN 6 MeV. Ulpat, Jean-Pierre; Pornet, Jacqueline; Duigou, Marcel (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Apr 1972. 33p. (In French). Dep. NTIS (U. S. Sales Only).

Various identification functions are studied. Particular attention is given to problems arising from fluctuations associated with the thin detector used. These fluctuations, which are of electronic origin, are negligible at higher energies. They are comparable with Landau fluctuations. The influence of this effect on the identification function is analyzed. The function $y = [E_2 + (dE/2) + C]\ dE$ is recommended as it simultaneously allows the correct separation of p, d, t, and ^{3}He, ^{4}He. A comparison is made between the advantages of an analog treatment, a batch numerical treatment, and an on-line of the E and (dE/dx) information. (auth)

36141 (CONF-720430–1) SCANNING SYSTEM WITH TWO DATA CHANNELS, DATA REDUCTION AND DISPLAY. Bell, P. R.; McClain, W. J.; Ross, D. A.; East, J. K.; Moore, E. C. (Oak Ridge National Lab., Tenn.). Apr 1972. 15p. Dep. NTIS.

From 2nd symposium on the sharing of computer programs and technology in nuclear medicine; Oak Ridge, TN. (21 Apr 1972).

An on-line computer-based scanning system for the acquisition, processing, and display of rectilinear scan images is described. A computer for this system requires 8 k words of core and a 32 k word magnetic disk. Signal requirements, system operating modes, data access, data processing, and data display are briefly discussed. (W.H.K.)

36142 (DESY–72/13) HARDWARE LOGIC FOR THE SELECTION AND ANALYSIS OF EVENTS OBSERVED IN CHARPAK-CHAMBER AND COUNTER EXPERIMENTS. Iarocci, E.; Waloschek, P. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1972. 31p. Dep. NTIS (U. S. Sales Only).

The general organization of a system using standard integrated circuits in simple configurations is described. Emphasis is given to the use of shift registers for sequential pattern recognition operations. (13 figures) (auth)

36143 (EUR–4783) INVESTIGATION OF SOME PROPERTIES OF THE PRECISION LONG COUNTER. Massand, O. P. (European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). 29 Oct 1971. 60p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 85.-.

The Precision Long Counter (PLC) has been introduced by J. De Pangher in order to get a reproducible counter for neutron flux density measurements. This counter is believed to have the characteristics of a standard instrument. A combined order of thirteen PLC's for West European laboratories was organized from the Central Bureau for Nuclear Measurements and the present counter is one of them. An effort has been made to set up this PLC and to do its calibration with internal and external radioactive neutron sources and monoenergetic accelerator neutrons and to finally rrive at its energy response. Some of the measurements carried out with this PLC are described. (EURATOM)

36144 (LNF–71/21) STUDY OF A NEUTRON COUNTER: NERGY RESPONSE AND EFFICIENCY. Sciacca, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 May 1971. 14p. (In Italian). Dep. NTIS (U. S. Sales Only).

The measurement of the increase of the slit energy of a plastic scintillator was measured as a function of the discriminator threshold. Using these parameters, together with the geometric dimensions and the chemical composition of the scintillator as input data for a Monte Carlo program, it was possible to calculate the detection efficiency of neutrons for energies from 0 to 300 MeV. (tr-auth)

36145 SEALED TITANIUM WINDOW PROPORTIONAL COUNTER FOR THE DETECTION OF $^1/_2$ keV X RAYS. McClintock, J. E.; Levine, A.; Rappaport, S. (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instrum.; 43: No. 6, 902-5(Jun 1972).

A sealed Ti window proportional counter sensitive to x radiation in the energy range 0.35 to 0.45 keV and >1.5 keV is described. Measurements of the Ti mass absorption coefficients and a graphical summary of the literature values are presented. For a proportional counter with a 930-μg/cm^2 (2.1-μ) Ti window, the peak efficiency at 0.45 keV is found to lie between 4.6% and 7.1%. An application in x-ray astronomy involving a rocket observation of Sco X-1 is discussed. (auth)

36146 VERSATILE, SELF PRESSURE REGULATING PROPORTIONAL COUNTER FOR SPACE APPLICATIONS. Francey, R. J.; Wilson, B. G. (Simon Fraser Univ., Burnaby, British Columbia). Nucl. Instrum. Methods; 100: No. 3, 541-3(1972).

A proportional counter is operated at the vapor pressure of a liquid reservoir. Advantages include flexibility of gas selection, engineering simplicity, and economy. (3 figures, 1 table) (auth)

36147 SCINTILLATION PULSE SHAPE MEASUREMENT WITH THE LINEAR GATE AND INTEGRATOR (2144). Meggitt, G. C.; Collinson, A. J. L. (Polytechnic of the South Bank, London). Nucl. Instrum. Methods; 100: No. 3, 485-91(1972).

A system is described for the determination of scintillation pulse shapes with decay times in the range 10 ns to 100 μs. The current pulse from a photomultiplier tube is gated by electronic circuitry; a summing system was devised so that the amplitude of the pulse at different times may be derived directly from digital voltmeter readings. A detailed comparison is made with the more generally used single photon time interval analysis method. With slight modification this system could be employed for the measurement of current pulses from other sources such as semiconductor radiation detectors. (2 figures) (auth)

36148 EFFECTS OF NEUTRON-INDUCED CRYSTAL DEFECTS ON THE FLUORESCENCE DECAY TIME OF ANTHRACENE AND STILBENE. Roemer, M.; Schneider, H. (Justus Liebig-Univ., Giessen, Ger.). Nucl. Instrum. Methods; 100: No. 3, 477-80(1972). (In German).

Artificial lattice defects were produced in anthracene and stilbene crystals by irradiation with 14-MeV neutrons; the influence on the pulse shape of fluorescence emission and on the method of "pulse shape discrimination" was investigated. At doses of 200 krad the decay time of the fast scintillation component was shortened about 29 ± 4.5% in anthracene and 9.7 ± 2% in stilbene, independent of the mode of excitation. The time constant of the slow component was increased: in anthracene 12.2 ± 3% for α excitation and 15.2 ± 3.5% for β excitation, in stilbene 13 ± 3% (α) and 56.7 ± 8% (β). With respect to the method of "pulse shape discrimination," this change in decay times causes only a small decrease in separation between α and β particles in stilbene; an increase in separation occurs in anthracene. All results are in accordance with the present theory of delayed fluorescence. A "medium component" (ca 50 ns), introduced for a correct fitting of the decay curve, was found to be a part of the delayed fluorescence. (6 figures) (auth)

36149 LIMIT OF PRECISION IN NUCLEAR AND ANALYTICAL CHEMISTRY. Currie, L. A. (National Bureau of Standards, Washington, D. C.). Nucl. Instrum. Methods; 100: No. 3, 387-95(1972).

The precision associated with an experiment in nuclear chemistry or activation analysis is commonly estimated by means of Poisson counting statistics. Such an estimate, as well as the conclusion that the precision may be indefinitely improved by increasing the number of counts obtained, is necessarily wrong when additional sources of random error are operating. Knowledge of the additional, non-Poisson component of random error is required for reliable estimates of parameters and their standard errors, to detect model errors, to plan counting experiments efficiently, and to establish the limit of precision when the Poisson counting error becomes negligible. For these purposes, an iterative computation program—XESS—was developed to take into account the additional variance and unequal statistical weights. The significance and detectability of excess variance is illustrated with data from studies of photonuclear reactions and activation analysis. (2 figures, 3 tables) (auth)

36150 TRACK LENGTHS OF HEAVY IONS IN MICA. Blok, H.; Kiely, F. M.; Pate, B. D. (Simon Fraser Univ., Burnaby, British Columbia). Nucl. Instrum. Methods; 100: No. 3, 403-11 (1972).

The etching conditions under which visible tracks are developed in mica previously irradiated with heavy ions were studied. The registration threshold was found to lie between ion charge $Z = 10$ and $Z = 13$. Track lengths were measured for aluminum, nickel, argon, krypton, and gold ions in the energy range 0 to 1.0 MeV/nucleon. The data were compared with range predictions of Lindhard et al., and are consistent with etching for that part of the ion trajectory within which the stopping power exceeded a critical value of 10.1 MeV/mg/cm^{-2}. The probability for registration of all ions studied heavier than neon, incident on the mica at 30° to the surface, was found to be indistinguishable from unity. (6 figures, 1 table) (auth)

36151 DISPERSION OF THE AMPLITUDE SPECTRUM OF γ-RAY DETECTORS. Katkov, V. P.; Krupman, A. I.; Taksar, I. M. Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 7, 1214-17 (Jan 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 7, 1382-6(Jul 1971).

The energy dependence of the resolution of semiconductor particle detectors, which is to a great extent determined by the quality of the detector material, is needed in spectrometric investigations. A consistent derivation is given of the expression for the dispersion of the amplitude spectrum δ_E, which can be used to estimate the importance of the distribution of the mean free paths of carriers. It is shown that a considerable contribution to δ_E is made by the term which is quadratic in the energy and is independent of fluctuations in the distribution of carrier-capture centers. Numerical estimates are given for the case of point absorption of γ-ray quanta. It is assumed that charge losses during collection occur only in localization processes. (auth)

36152 TECHNIQUE FOR MEASUREMENT OF THERMAL NEUTRON DISTRIBUTIONS AT THE SURFACES OF CYLINDERS. Doutriaux, D. G.; Andrews, D. G. (Univ. of Toronto). Nucl. Instrum. Methods; 101: No. 2, 257-61(1972).

A technique was developed for measuring the angular variation of thermal neutron flux near an absorbing cylinder placed in a moderator. A copper detector wire was encased in a cadmium sheath having a very fine collimated slot along one generatrix, so that its activation was proportional to the integrated flux in the axial plane and to the differential flux in the transverse plane. It was used, inter alia, to measure the flux near a 1.00 inch diameter copper bar and a 1.00 inch OD, 0.75 inch ID, copper tube. The results were found to be consistent with data calculated by usual theoretical and semi-theoretical methods. (auth)

36153 DETECTOR FOR (n,γ) CROSS SECTION MEASUREMENTS. Hellstroem, J.; Beshai, S. (Atomic Energy Co., Nykoeping, Sweden). Nucl. Instrum. Methods; 101: No. 2, 267-73 (1972).

A new detector to be used for determining (n,γ) cross sections has been developed. The detector is a large liquid scintillator of approximately 4π geometry. A special coincidence requirement made it possible to increase the signal to background ratio by a factor of two. When used in an experiment with a pulsed beam (fwhm 5 ns) the overall time resolution was found to be 10 ns. Experiments performed in the lower keV region were found to agree well with previously reported data. (auth)

36154 LIGHT RESPONSE AND PULSE SHAPE DISCRIMINATION PROPERTIES FOR NE 232. Bovet, E.; Boschung, P.; Rossel, J. (Universite de Neuchatel, Switzerland). Nucl. Instrum. Methods; 101: No. 2, 315-19(1972).

The light response of the fast liquid scintillator NE 232 to electrons and deuterons has been measured in the energy range 0.16 to 4.2 MeV and 0.7 to 10 MeV, respectively. The pulse shape discrimination properties of NE 232 are compared with those of NE 213 and NE 230. The zero-crossing method has been applied for that purpose. (auth)

36155 RESPONSE OF IMPURITY ACTIVATED ALKALI-HALIDE SCINTILLATORS. Ladu, M. (Universita de Cagliari Italy); Pelliccioni, M.; Roccella, M. Nucl. Instrum. Methods; 101: No. 2, 383-9(1972).

A model for the interpretation of the response curves of impurity activated alkali-halide scintillators is proposed. The work takes into detailed account the excitation mechanism of luminescent centers. Within the limits of the proposed model, a good agreement can be obtained with experience both for light ($Z < 5$) and heavy ions. The theory, which agrees with experience, turns out to be detailed enough to allow for the determination of a law of dependence of luminescence efficiency, for electrons and γ-rays, on the impurity concentration in crystal. (auth)

36156 SOLID ANGLE SUBTENDED BY A CIRCULAR CYLINDER. Verghese, K.; Gardner, R. P.; Felder, R. M. (North Carolina State Univ., Raleigh). Nucl. Instrum. Methods; 101: No. 2, 391-3(1972).

The solid angle subtended at a point by the lateral surface of a right circular cylinder is approximated by replacing the cylinder surface area seen from the point by a regular polygonal cylindrical surface. This approximation combined with a similar approximation for the solid angle subtended by a circular disc, enables the calculation of the total solid angle from a right circular cylinder to any desired degree of accuracy. (auth)

36157 DETECTION EFFICIENCY AND THE RESPONSE FUNCTION OF SEMICONDUCTOR PROTON RECOIL COUNTERS WITH AXIAL SYMMETRY TO A POINT NEUTRON SOURCE. Gotoh, H.; Yagi, H. (Japan Atomic Energy Research Inst., Tokai-mura). Nucl. Instrum. Methods; 101: No. 2, 395-6(1972).

The detection efficiency and the response function of semiconductor radiator proton recoil counters with axial symmetry to a point neutron source are given in a single integral form with a composed function of elementary functions as integrand. (auth)

36158 EXPERIMENTAL SET UP TO STUDY THE LIGHT NUCLEI PRODUCTION IN p-NUCLEUS INTERACTION. Roche, G. (Univ., Clermont, France); Costilhes, J. P.; Alard, J. P.; (and others). Nucl. Instrum. Methods; 101: No. 12, 231-41(1972).

The experimental method to study the light nuclei production in p–nucleus interaction is given. The experimental set up is described. It consists of a telescope $E-\Delta E$ and an electronic equipment which allows registration on perforated tape of both E and ΔE pulse heights. The data analysis is then performed on a computer. A large energy range is covered by means of two telescopes associating respectively two Si detectors and a Si detector with a NaI(Tl) scintillator. Typical results which show the performances of the set up are given. (auth)

36159 HIGH-ENERGY NEUTRON DETECTION BY THORIUM-COATED FISSION COUNTERS. Parikh, V. R. (Physical Research Lab., Ahmedabad, India). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 375-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A fission detector constructed by electro-deposition inside a copper cylinder with a smooth coating of thorium (^{232}Th) and operated in the proportional region is discussed. Some characteristics of this counter and its application to balloon-borne neutron experiments are given. (auth)

36160 DETERMINATION OF SENSITIVITY OF VARIOUS PLASTIC DETECTORS. Beaujean, R.; Enge, W.; Meyerbroeker, H. (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 387-90(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Two methods have been developed to determine the sensitivity of various plastic materials for track registration. The sensitivity of a given material is defined as the critical energy up to which a given particle can be recorded. In plastic sheets which record alpha particles the sensitivity and the track etching rate in the region of the critical energy can be obtained using the track diameter curves for vertical incident alpha particles. Another method makes it possible to study less sensitive materials (e.g., polycarbonate sheets), too. After exposing the material to a high proton flux, pits can be etched which are probably produced by recoil nuclei. The number of these pits depends on the sensitivity of the material and the energy and flux of the protons. (auth)

36161 PRELIMINARY RESULTS OF MEASUREMENTS ON TRACK OF HEAVY COSMIC RAYS IN PLASTIC DETECTORS. Enge, W. (Univ., Kiel); Bartholomae, K.-P.; Fukui, K.; Filz, R. C. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 391-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A stack of 30 plastic sheets was flown at 1.5 g/cm^2 altitude for 10 hours from Fort Churchill, Canada. 8% of the area was covered on both sides by 600 μm thick Ilford G5 emulsions. The aim was to measure the charge spectrum and flux (a) of all particles stopping within the stack, i.e. from Ne-ions of 110 to 190 MeV/nucleon up to Fe-ions of 180 to 320 MeV/nucleon, (b) of all relativistic particles of $Z \geq 32$ and (c) of all relativistic particles of $Z \geq 55$. A part of the stack has been etched; 103 stopping particles were found and analyzed in the plastic sheets and the emulsions. This method as well as preliminary results are discussed. (auth)

36162 SIMPLE METHOD OF PULSE-SHAPE DISCRIMINATION FOR SCINTILLATION COUNTING. Barton, J. C. (Northern Polytechnic, London). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 403-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

For cosmic ray applications a pulse shape discrimination method needs to operate over a wide energy range. It is shown that successful discrimination can be obtained very simply by using two of the "ringing coil" type of multi-channel analysers with different natural frequencies. Examples of the use of this method are given, and a spectrum of heavily ionizing events in a liquid scintillator at sea level deduced. This method is compared theoretically and experimentally with other discrimination methods. Although rather less efficient, its simplicity may make it useful in some applications. (auth)

36163 NEW DESIGN OF NEUTRON COUNTER WITH HIGH EFFICIENCY. Barton, J. C.; Caines, P. J. (Northern Polytechnic, London). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 411-16(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Typical arrays of boron trifluoride counters in a paraffin wax moderator have detection efficiencies of only a few percent for fast neutrons. The efficiency can be increased by using more counters, but this becomes very expensive. A new type of neutron detecting element has been developed which uses a mixture of enriched lithium fluoride and activated zinc sulphide spread in thin layers on the inner surfaces of cylindrical holes in a hydrogenous moderator. Wavelength shifting light-guides, made from a sandwich of fluorescent and clear "Perspex", transmit the light from many elements to a single photomultiplier. In the prototype counter the efficiency for 1 MeV neutrons is 25% and the background counting rate small. (auth)

36164 SATELLITE-BORNE SEMICONDUCTOR TELESCOPE FOR IDENTIFICATION OF RELATIVISTIC HEAVY PRIMARY COSMIC RAYS. Nakagawa, S. (Rikkyo Univ., Tokyo); Tsukuda, M.; Yoshimori, M.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 449-55(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

It is considered that the analysis of the chemical composition and energy spectrum of heavy primary cosmic rays yields important information on the origin and propagation mechanism of cosmic rays. Detector telescopes consisting of several silicon semiconductor detectors are made to identify nuclear charges of relativistic primary cosmic rays from proton to iron group nuclei. The minimum pulse selection method is applied to detector telescopes to increase the resolving power for identification of cosmic ray particles. The experimental test of this telescope was made with high energy electrons and the result showed that the minimum pulse selection method was useful for increasing the resolving power for identification of heavy cosmic ray particles. In addition, a pair of Cherenkov detectors are used to reject low energy atmospheric secondary particles and determine incident directions of particles. Particle rigidities below 60 GV are determined by utilizing the East–West asymmetry of the geomagnetic field. As a preliminary experiment, the balloon observation was carried out in Sept. 1967 and the expected result was obtained. These detector telescopes were put aboard a Japanese satellite CORSA scheduled for launch in 1971. (auth)

36165 RADIATION DETECTORS. Dudley, R. A. (International Atomic Energy Agency, Vienna). pp 19-41 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

The design, operation, and characteristics of scintillation detectors and ionization detectors are described. Inorganic crystalline scintillators, organic scintillators, Geiger–Mueller counters, proportional counters, and ionization chambers are discussed. (W.H.K.)

36166 ASSOCIATED ELECTRONIC EQUIPMENT. Greatorex, C. A. (St. Bartholomew's Hospital, London). pp 42-63 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

The various electronic units used in radiation detecting systems are described. Topics related to pulse measurements include pulse amplifiers, discriminators, coincidence and anticoincidence circuits, pulse-height analyzers, scalers and ratemeters, power supplies and counting systems. Quartz-fiber electrometers, valve electrometers, and vibrating-reed electrometers for direct-current measurements are briefly described. (W.H.K.)

36167 STATISTICAL FACTORS AFFECTING RADIOACTIVITY MEASUREMENTS. Veall, N. (Clinical Research Centre, Harrow, Eng.). pp 64-78 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

Topics include the statistics of counting measurements, practical aspects of background measurements, choice and optimum adjustment of counting equipment, and digital and analog recording of counting rate. (W.H.K.)

36168 MEASUREMENT OF RADIOACTIVITY IN VITRO. Belcher, E. H. (International Atomic Energy Agency, Vienna). pp 79-117 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

Methods for gamma ray measurements are outlined including scintillation counters for small and large samples and Geiger–Mueller counters. Methods for beta-ray measurements discussed include well-type scintillation detectors; jacketed, thin-window, and internal-sample Geiger–Mueller counters; gas counting techniques; and internal-sample liquid scintillation counters. Also, measurement of radioactivity on electrophoresis strips and chromatograms, autoradiography, and absolute radioactivity measurements are discussed. (88 references.) (W.H.K.)

36169 MEASUREMENT OF RADIOACTIVITY IN VIVO. Trott, N. G. (Inst. of Cancer Research and Royal Marsden Hospital, Surrey, Eng.). pp 118-57 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

Topics include radiation detectors for in vivo measurements, measurement of radioactivity in individual organs and tissues, methods of localization of radioactivity, and measurement of whole-body radioactivity. (105 references.) (W.H.K.)

36170 LAMINAR FLOW CELL. Randolph, Henry W. (to United States Atomic Energy Commission). U. S. Patent 3,649,829. 14 Mar 1972. Filed 6 Oct 1970.

A sample fluid, containing, for example, radioactive material, is made to flow as an integral core within a column of inert fluid through the sensitive zone of a monitor such as a radiation detector. The inert fluid acts as a sheath to prevent contamination of stationary surfaces within the sensitive zone. Sample fluid is injected into the flow of inert fluid with a minimum of turbulence and mixing. (auth)

36171 LAMINAR GAS FLOW RADIATION DETECTOR. Randolph, Henry W. (to United States Atomic Energy Commission). U. S Patent 3,649,834. 14 Mar 1972. Filed 6 Oct 1970.

A radiation detector for high resolution measurement of energy spectra in flowing gas samples has a first electrode, a parallel second electrode of opposite polarity, and a detection chamber between the two electrodes. An integral pulse or stream of sample gas is passed in laminar flow through the detection chamber. A nonradioactive gas flows around the stream of sample gas to prevent contact and contamination of either electrode with radioactive material, as well as to absorb the radiation from the sample gas for detection. (auth)

36172 BROADBAND CONVERTER FOR CONVERTING THE CURRENT OF SEMICONDUCTOR NUCLEAR-RADIATION DETECTORS INTO A SEQUENCE OF PULSES. Zharkov, S. A.; Vasil'ev, I. M.; Perepechaev, V. V.; Sidorenko, A. V.; Khokhlova, M. M. (Leningrad Inst. of Aviation Instrument Design). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1064-6 (Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 101-3(Jul-Aug 1971).

A broadband circuit for converting the current of semiconductor nuclear-radiation detectors into a sequence of pulses is described, which is designed using the equivalent of a four-layer diode. The stabilization of the bias applied to the control electrode allowed an extension of the dynamic range of information conversion by a factor of approximately 20, a reduction in the number of circuit elements, and a reduction in the electrical energy drawn by the circuit. (auth)

36173 NETWORKS FOR PARTICLE IDENTIFICATION ACCORDING TO THE SHAPE OF THE SCINTILLATION SIGNALS (REVIEW). Brovchenko, V. G. (Atomic Energy Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 953-74(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 7-28(Jul-Aug 1971).

Devices are considered which identify the signals of simple (uncombined) scintillation counters. Classification of identifying networks according to their principle of operation includes the optimal filter method, comparison of total and fast charges, comparison of fast and slow charges, comparison of total and slow charges, comparison of the amplitudes of the fast and slow components of the current, identification methods based on the deexcitation time, and other methods. The different methods are described and compared. (76 references) (W.H.K.)

36174 DETECTOR WHICH IS SENSITIVE TO THE SPOT AT WHICH NEUTRONS HAVE BEEN TRANSMITTED. Goshchitskii, B. N.; Sidorov, S. K.; Chernobrovkin, V. V.; (and others) (Inst. of Metal Physics, Sverdlovsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1002-5(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 51-4(Jul-Aug 1971).

A method is described for determining the spot at which neutrons have been transmitted according to the ratio between the amplitudes of the output pulses from opposite ends of a proportional counter having a high-resistance collector. An estimate is made of the intrinsic space resolution of such a counter for the case in which the primary ionization is carried out by secondary particles generated as a result of a nuclear reaction rather than by the recorded particle itself; the tracks of the secondary particles are randomly oriented relative to the counter filament. Results are presented of measurements of the spatial position of neutron beams. (auth)

36175 TRAVELING-WAVE SCINTILLATION DETECTOR. Gorbachev, V. M.; Korolev, V. N.; Chumak, A. D. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1039-41(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 80-2(Jul-Aug 1971).

A method is described for constructing a scintillation detector which records the shape of short radiation pulses and has an increased (by a factor of approximately 100) quantum sensitivity. The increasing in sensitivity is achieved by summing the signals in a long line using the traveling-wave method, and likewise by the parallel connection of the outputs of long lines. The time resolution of the detector is at worst 9 nsec. (auth)

36176 CALIBRATION OF SCINTILLATION TRITIUM COUNTERS. Balonov, M. I. (Scientific-Research Inst. of Radiation Hygiene, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1042-3(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 82-4(Jul-Aug 1971).

A method is described for determining the efficiency with which tritium is recorded in liquid scintillation counters. The use of an x-ray simulator of tritium radiation as the radioactive standard increases the accuracy and operativeness of the calibration. (auth)

36177 INCREASING THE EFFICIENCY OF COINCIDENCES AND ANTICOINCIDENCES IN WORKING WITH A CsI(Tl) SCINTILLATOR. Bystritskii, V. M.; Dzhelepov, V. P.; Ermolov, P. F.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1047-9(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 86-8(Jul-Aug 1971).

A method is proposed for increasing the efficiency of coincidences and anticoincidences in working with a CsI(Tl) scintillator under the conditions of low luminescence yield and poor light collection on the photomultiplier photocathode. The statistical analysis of the photomultiplier signals, which is carried out by means of simple electronic circuits, allows considerable reduction of the background in the random coincidences without reducing the efficiency with which coincidences are recorded. For example, in recording muon stopping events in a gas hydrogen target using conventional methods the counting rate of random coincidences was 83 $\sec^{-1}$, while it was 12 $\sec^{-1}$ for the same stopping-event recording efficiency when the proposed method was used. (auth)

36178 IONIZATION CHAMBER FOR MEASUREMENT OF HIGH TRITIUM CONCENTRATIONS. Belovodskii, L. F.; Gaevoi, V. K.; Grishmanovskii, V. I. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1050-2(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 88-90(Jul-Aug 1971).

The construction and characteristics of a flat four-section ionization chamber having a volume of 0.1 liters are described. The chamber allows measurement of the activity of T to 50 C (500 C/liter) in a saturation mode for a supply voltage of 3000 V. The chamber was calibrated with respect to T by means of a MV-2302 mass spectrometer; the energy losses in the chamber walls are 10 ± 1%. (auth)

36179 OBTAINING THE LIMITING RESOLVING POWERS OF LOW-NOISE PREAMPLIFIERS BASED ON FIELD-EFFECT TRANSISTORS AT 25°C. Sedov, N. Ya. (Physical-Technical Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1069-72(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 106-9(Jul-Aug 1971).

It is shown that the resolving power of the preamplifiers which are used is determined by parasitic coupling rather than by the noise of the field-effect transistors. The resolving power of the preamplifier, as determined solely by the transistor noise at 25°C, was obtained (0.54 keV for a Ge-detector). (auth)

36180 SEMI-MICROSCANNING DEVICE USING A MINIATURE SILICON–LITHIUM SEMICONDUCTOR PROBE. Meyer, E.; Challier, J. C.; Sternberg, J. (Univ. of Montreal). Int. J. Appl. Radiat. Isotop.; 23: No. 5, 251-2(May 1972).

A study is described on the use of a prototype semi-microscanning device employing a semiconductor probe in biological experiments. The small size of miniature semiconductor probes has resulted in a wide range of applications in the biomedical field, and detectors with a spatial resolution of 1 to 2 mm have been used in blood flow measurement, for eye tumor localization, and many other purposes. This, however, is claimed to be the first report on the use of miniature scanning devices with semiconductor detectors. A semiconductor detector of the Si(Li) type was employed with a probe of 3.5 mm dia and 15 mm length. Rats injected with colloidal ^{198}Au were used in the studies, which involved liver scanning. A typical scan is reproduced, and results corresponded well with other techniques. The β counting efficiency proved high enough to allow scanning of tissue sections containing ^{198}Au in concentrations frequently met in radiobiological research (in the range 1 μCi/g). Automation and computerization are in progress. (UK)

36181 COMPARISON BETWEEN MATERIALS USED FOR LIQUID SCINTILLATION COUNTING VIALS. Butterfield, D.; McDonald, R. J. (Australian National Univ., Canberra). Int. J. Appl. Radiat. Isotop.; 23: No. 5, 249-51(May 1972).

A study was made of the parameter known as ''figure of merit' (M) for various materials used for liquid scintillation counting vials, M being defined as (efficiency)^2/background. The use of a vial material with a high M value is important, particularly in work involving samples of very low activity; this has led to the use of Teflon vials. Investigations were carried out to endeavor to elucidate the reason for Teflon's showing a higher M value than glass, silica, polythene, etc. An increase of efficiency was found on adding small pieces of Teflon rod to a standard solution contained in a glass vial. An Al vial with a SiO_2 window was constructed to enable direct comparison between various materials by fitting sleeves of these materials inside the vial; in this way all factors stayed constant except the material forming the effective wall of the vial, and meaningful comparison could be made. Pulse height spectra for the vial with and without the various sleeves are shown for ^{14}C and ^{36}Cl. It was noted, however, that Teflon could either cause an increase or a decrease in counting efficiency, depending on where the associated discriminations were set. It is suggested that free radicals in the Teflon may be the cause of the effect. (UK)

36182 GAMMA-SENSITIVE PROBE FOR HIGH-TEMPERATURE INDUSTRIAL APPLICATIONS. Berge, B.; Grjotheim, K.; Krohn, C.; Naeumann, R.; Toerklep, K. (Technical Univ. of Norway, Trondheim). J. Phys., E (London); 5: No. 6, 608-11 (Jun 1972).

A newly developed high-temperature gamma radiation probe for in situ determination of radioactivity in high-temperature media is described. Some applications in the aluminum industry are demonstrated. (auth)

Radiation Dosimeters

Refer also to abstract 36649.

36183 (ORNL-4720, pp 95-106) APPLIED DOSIMETRY RESEARCH. Becker, Klaus; Cheka, J. S.; Crase, K. W.; Gammage, R. B.; Gillespie, F. E.; Moreno-Moreno, A.; Sohrabi, M. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

- RAD DET, DIELECTRIC TRACK—particle track etching studies at ORNL, p. 104-106
- RADIATION DOSIMETERS, EXOELECTRON—development and research on BeO, at ORNL, p. 95-103
- RAD DOS, THERMOLUMINESCENT—development and research at ORNL, p. 103-104 (W.H.K.)

36184 PORTABLE CALORIMETER FOR X-RAY MEASUREMENTS OF FLUENCE AND FRONT SURFACE DOSE SIMULTANEOUSLY. Wood, D. S. (Physics International Co., San Leandro, Calif.). Rev. Sci. Instrum.; 43: No. 6, 908-10(Jun 1972).

A small, easily portable, and highly sensitive x-ray calorimeter was constructed to measure fluence and front surface dose in tantalum from pulsed electron accelerations. Exceptional temperature stability (hence, exceptional sensitivity) is achieved by mounting the absorbers in an isothermal cavity cooled by an ice reservoir. Calibration of the x-ray fluence absorber was made by direct exposure to a 400 Ci ^{137}Cs γ-ray source. (auth)

36185 FILM BADGE RADIATION DOSIMETER FOR DETECTING RADON. Evans, Robley D. U. S. Patent 3,655,975. 11 Apr 1972. Filed 4 Apr 1966.

A dosimeter containing photographic film for detecting radon, its daughters, and other alpha emitters such as might be found in uranium mines is described. The dosimeter embodies a light-tight film holder with a number of passages which permit air containing alpha-emitting nuclides to enter the dosimeter. With proper choice of film other radiations in other fluids can be detected. (3 figures) (R.W.R.)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 37485.

36186 (CEA-R--4319) AN ACCURATE ANALOGUE-DIGITAL CONVERTER FOR NUCLEAR SPECTROMETRY. **Goursky, Vsevolod (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1972. 124p. (In French). Dep. NTIS (U. S. Sales Only).**

Thesis. Submitted to Paris Univ. (France). Faculte des Sciences.

A "WILKINSON" type analogue-digital converter, intended as the measurement part of an amplitude analyzer, is described. The apparatus consists of two units: an amplitude-time converter and a coding scaler; different coding scalers may be used with the same amplitude-time converter: a 100 MHz current scaler, a more expensive 200 MHz scaler and in the near future a 300 MHz scaler. The characteristics and the performance obtained are as follows: differential nonlinearity with the coding scaler unit at 100 MHz = 0.3 percent for 98 percent of the channels; differential nonlinearity with the coding scaler unit at 200 MHz = ±0.4 percent for 98 percent of the channels; integral nonlinearity $<\pm 1.5 \times 10^{-4}$; base threshold instability <0.15 mV/°C, conversion slope instability $<5 \times 10^{-5}$/°C; conversion slope 512, 1024, 2048, 4096-8192 channels for 10 volts F = 100 MHz, and 1024, 2048, 4096, 8192–16384 channels for 10 volts F = 200 MHz. (auth)

36187 (IJS-P--276) MEASUREMENTS OF PARTIAL CROSS SECTIONS OF PHOTONUCLEAR REACTIONS LEADING TO DIFFERENT STATES OF RESIDUAL NUCLEI. **Brajnik, D. (Institut Jozef Stefan, Ljubljana (Yugoslavia)). Dec 1971. 77p. (In Slovenian). Dep. NTIS (U. S. Sales Only).**

A spectrometer for protons and other charged particles, emitted in the photonuclear reactions is described. Charged particles are analyzed by means of silicon surface barrier detectors placed at different angles around a thin target. The target is irradiated by the bremsstrahlung beam from a 33 MeV betatron. Angular distributions can be measured at eight angles between 30° and 150°. In a separate experiment the extent of the population of the states of residual nuclei is determined by measuring the deexcitation γ-rays from the reactions $(\gamma,p\gamma')$, $(\gamma,n\gamma')$. A new method of analysis of the photoparticle spectra has been developed using information obtained from the deexcitation γ-ray experiment. From the photoparticle spectra measured at different end point energies, cross sections to the strongly populated states in residual nucleus are obtained by solving a set of linear equations by the method of least squares. The apparatus and method of analysis was checked on some light nuclei. (auth)

36188 (LNF-71/76) EXPERIMENTAL ARRANGEMENT AT HIGH RESOLUTION FOR THE MEASUREMENT OF γ SPECTRA FROM 100 TO 1000 MeV. Benvenuto, P.; Fabbri, D.; Lodi-Rizzini, E.; Maiani, L.; Napolitano, M.; Piazza, A.; Rossi, V.; Susinno, G.; Votano, L. (Comitato Nazionale per l'Energie Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 26 Nov 1971. 7p. (In Italian). Dep. NTIS (U.S. Sales Only).

A high resolution e^+e^- pair spectrometer which accepts very collimated γ beams was constructed. This spectrometer consisted of a small-gap analyzer magnet, two scintillation chambers for the detection of the two particles and the locating of their trajectories, three scintillation counters for detecting the events, and the electronics which control the device. Each of these components are described. (J.S.R.)

36189 VERSATILE SOFT X-RAY APPEARANCE POTENTIAL SPECTROMETER. **Long, Robert L. Jr.; Beavis, Leonard C. (Sandia Labs., Albuquerque, N. Mex.). Rev. Sci. Instrum.; 43: No. 6, 939-41(Jun 1972).**

The construction of a simple and versatile soft x-ray appearance potential spectrometer is described. The soft x rays are detected by measuring the positive current produced by photoemission from a stainless steel photocathode: this method enables the detector circuit to be near ground potential and permits operation under pressures greater than 10^{-7} torr. Typical operating conditions are described. (4 figures) (auth)

36190 DELAYED COINCIDENCE MEASUREMENTS USING PHOSWICH SCINTILLATORS. **McBeth, G. W.; Winyard, R. A. (Brighton Polytechnic, Eng.). Nucl. Instrum. Methods; 100: No. 3, 413-18(1972).**

The use of single scintillators and phoswich layer scintillators in delayed coincidence measurements is described. The practicalities of the method are demonstrated by measurements of the half-lives of the $5/2^-$, 59.6-keV level of ^{237}Np and the $5/2^+$, 86.6-keV level of ^{233}Pa. The values obtained were 66.9 ± 1.0 ns and 35.7 ± 0.4 ns, respectively, in good agreement with previous determinations. Some possible applications of the techniques are also discussed. (8 figures, 2 tables) (auth)

36191 MONTE CARLO CALCULATION OF RECOIL SPECTRA IN ^{4}He PROPORTIONAL COUNTERS. **Atwater, H. F. (Los Alamos Scientific Lab., N. Mex.). Nucl. Instrum. Methods; 100: No. 3, 453-7(1972).**

Monte Carlo techniques were used to calculate alpha-particle recoil spectra in ^{4}He proportional counters for incident neutron energies from 0.4 MeV to 14.0 MeV. Wall and end effects are treated explicitly. Effects of local counter inhomogeneities and external electronics are simulated by using a Gaussian distribution of the detector response in discrete energy groups. Calculated results are compared with measured recoil spectra. (auth) (8 figures, 1 table) (auth)

36192 X-RAY FILTERS. **Broquet, Claude (to Commissariat a l'Energie Atomique). French Patent 2,046,014. 22 Feb 1971. Filed 21 Mar 1969. (In French).**

A fabrication process for x-ray filters used in spectrometry to effect a quantitative analysis by the Ross double-filter method was developed. The filter presented is made of an element with an absorption discontinuity. A thin flexible plate contains this element in the form of a powder bound by a nonabsorbing organic binder. A foil made of a flexible material transparent to x-rays covers each face of the plate and ensures its mechanical protection. (France)

36193 TECHNICAL PROGRESS IN Si(Li) DETECTORS FOR X-RAY SPECTROMETRY. **Aitken, D. W. (Stanford Univ., Calif.); Woo, E. Method. Phys. Anal.; 7: No. 4, 335-48(Dec 1971). (In French).**

Improvements in the resolution of both small- and large-area detectors for both low and high counting rates are discussed. Differences are indicated between the experimental and theoretical performances. The performance of the detector and the detector–electronic system combination are discussed. The relative advantages of Si detectors over Ge detectors are indicated, and the absolute advantage of Si in the x-ray range is stressed. Three applications outside the x-ray region illustrate other important advantages of Si detectors. (France)

36194 INVESTIGATION OF A ^{6}Li SEMICONDUCTOR SANDWICH SPECTROMETER FOR ITS CHARACTERISTICS AND PERFORMANCES. **Yang, T. L. (National Tsinghua Univ., Hsinchu, Taiwan). Nucl. Instrum. Methods; 100: No. 3, 533-7(1972).**

Some characteristics and performances of a ^{6}Li semiconductor neutron spectrometer, such as low signal-to-background ratios outside a beam port, counting efficiency versus threshold energy setting, and matching difficulty, were studied. Energy calibration can be made with thermal neutrons by the characteristic peaks of 2.73-MeV tritons and 2.05-MeV alphas instead of monoenergetic neutrons from a Van de Graaff accelerator. (4 figures, 1 table) (auth)

36195 DEPENDENCE OF GAIN ON PLATE SEPARATION IN A PARALLEL PLATE CHANNEL MULTIPLIER. **Andersson, L. P.; Berg, S.; Hyder, A.; Jadrny, R.; Nilsson, Oe. (Univ. of Uppsala). Nucl. Instrum. Methods; 100: No. 3, 539-40(1972).**

The gain as a function of the distance between the two plates in a parallel-plate channel multiplier was investigated. The multipliers studied were found to function properly at plate distances down to 0.1 mm, with a pronounced maximum in gain at a separation of about 0.25 mm. (1 figure) (auth)

36196 PLASTIC SCINTILLATION DETECTOR FOR BETA-RAY SPECTRUM MEASUREMENTS. **Wohn, F. K.; Clifford, J. R.; Carlson, G. H.; Talbert, W. L. Jr. (Iowa State Univ., Ames). Nucl. Instrum. Methods; 101: No. 2, 343-52(1972).**

A scintillation detection system has been built for the determination of beta decay Q-values and ground state branching of short-lived fission products. The beta-ray response of the well-type plastic scintillators was determined by direct measurements of monoenergetic beta rays with energies up to 5 MeV. The beta-ray energy calibration, determined by continuous beta-ray spectra and internal conversion electrons, was found to have a partially quadratic energy dependence. A technique for using gamma-ray Compton spectra to obtain the energy calibration is described. The method of analysis of the distorted beta-ray spectra, which is successful in correcting the distortions down to one-tenth of the maximum beta-ray energy, allows the number of fit parameters to be reduced by application of constraints based on knowledge of the energy level scheme of the daughter nucleus. Sample results, which illustrate the quality of the fits to beta-ray spectra, are presented for ^{32}P and ^{137}Xe. (auth)

36197 VERSATILE MOESSBAUER SPECTROMETER AND ITS APPLICATIONS IN STRUCTURAL MECHANICS. Singh, J. J. (Langley Research Center, Hampton, Va.). Nucl. Instrum. Methods; 101: No. 2, 199-202(1972).

A versatile ^{57}Fe-Moessbauer spectrometer, equally efficient in transmission and reflection geometries, is described. The radiation detector consists of a 0.6″ × 2″ × 2″ rectangular NaI(Tl) crystal with a 0.6″ diameter hole. The front and back face of the crystal are covered with 0.005″ thick, 1.5″ diameter beryllium windows. The energy of the radiation accepted for counting ranges from 6.3 keV conversion x-rays to the 14.4 keV reemitted gamma rays. An application of the spectrometer involving low amplitude, low frequency, sinusoidal motion of the scatterer is described. (auth)

36198 TIME-OF-FLIGHT SPECTROMETER FOR ULTRACOLD NEUTRONS. Steyerl, A. (Univ., Munich). Nucl. Instrum. Methods; 101: No. 2, 295-314(1972).

A time-of-flight spectrometer for ultracold neutrons was developed and installed at the FRM Swimming-pool reactor Munich. The spectrometer consisting of a vertical curved neutron guide tube and a special chopper allows neutron total cross-section measurements in the energy range 10^{-7} to 5×10^{-4} with an energy resolution of about 20%. The neutron spectrum of the spectrometer was measured and found to be consistent with the theoretical expectation. A value of 0.97 was obtained for the reflectivity of the guide tube material (electrolytically polished copper tube). (auth)

36199 CALIBRATION OF A SCINTILLATION GAMMA SPECTROMETER. Polyakov, V. I.; Chechetkin, Yu. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1013-14(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 60-1(Jul-Aug 1971).

An analytic expression is derived for calculating the efficiency of recording by means of a cylindrical crystal. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 36682, 36977, and 37085.

36200 (ANL/HEP-7208(Vol.1), pp 125-8) ARGONNE EFFECTIVE MASS SPECTROMETER. Diebold, R. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The Argonne magnetostrictive spark chamber spectrometer for studying $\pi + \pi$ and $\pi + K$ scattering from $\pi^\pm + p$ and $K^\pm + p$ interactions is briefly described. (W.H.K.)

36201 (ANL/HEP-7208(Vol.1), pp 187-8) EXPERIMENTS WITH NEUTRAL PARTICLES IN THE FINAL STATE. Ruddick, K. (Minnesota Univ., Minneapolis. Dept. of Physics). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The development of large aperture, high resolution, photon shower detectors capable of incorporation in high statistics online experiments is suggested, and their features outlined. A whole class of reactions which could be studied with one setup using such a device is $\pi^- + p \to \pi^0(\eta^0) + n(\Delta^0)$ and $K^- + p \to \pi^0(\eta^0) + \Lambda(Y^{*0})$ reactions. (J.F.P.)

36202 (ANL/HEP-7208(Vol.2), pp 592-603) USE OF NEUTRON AND GAMMA-RAY DETECTORS IN MESON SPECTROSCOPY. Holloway, L. E. (Illinois Univ., Urbana). 1971. (COO-1195-220).

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The use of gamma detectors for the $\pi^- + p \to n +$ meson, where the meson decays into two gamma rays, is briefly discussed; and the technique of neutron time-of-flight spectroscopy for the $\pi^- + p \to n +$ meson interaction for calculating the mass and momentum of the missing neutral meson is described. (W.H.K.)

36203 (ANL/HEP-7208(Vol.3)) PLANNING FOR THE FUTURE. ZERO GRADIENT SYNCHROTRON WORKSHOPS, SUMMER 1971. Proceedings of a Series of Seven Workshops Held at Argonne National Laboratory, June 3–August 5, 1971. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 456p. Dep. NTIS.

Separate abstracts were prepared for each of the 42 papers in this volume. (R.W.R.)

For abstracts of individual papers see: 36204–36219, 36683–36688, 37074, 37075, 37120–37124, 37135–37137, 37214, 37228–37230, 37252, 37260–37262, 37273, and 37340.

36204 (ANL/HEP-7208(Vol.3), pp 708-12) NEUTRINO SCANNING. Mann, Anthony (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Results of scanning film from the 12-ft bubble chamber for neutrino reactions in hydrogen are discussed. Topologies of interest and sources of background are described. Several typical pictures are explained. Out of a total of 67,000 pictures, 13 fits were obtained to the reaction $\nu_\mu + p \to \mu^- + p + \pi^+$. (3 figures) (R.W.R.)

36205 (ANL/HEP-7208(Vol.3), pp 713-17) RECONSTRUCTION OF NEUTRINO EVENTS IN THE 12' CHAMBER. Schreiner, P. A. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Reconstruction of events corresponding to the interaction $\nu + p \to \mu^- + \pi^+ + p$ is discussed. Precise point reconstructions can be made out to the radial distances of the Scotchlite panels and down to the bottom of the chamber. Useful chamber depth is 175 cm. Typical errors on tracks are 6 MeV; they are dominated by multiple Coulomb scattering. The neutrino events were cleanly separated from the strong-interaction-induced background. The large size of the 12-ft chamber provides the ability to determine the mass of the charged tracks by observing secondary scatters, decays, and energy loss in the liquid. (5 figures) (R.W.R.)

36206 (ANL/HEP-7208(Vol.3), pp 718-24) PRESENT STATUS OF THE OPTICAL CONSTANTS FOR ANL 12-FOOT BUBBLE CHAMBER. Yuta, H. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The optical constants were improved since the first bubble chamber run. The method for obtaining these is briefly described. Distortions observed are about 7 μ at the end of the chamber; this distortion corresponds to about a 500 μ effect in space. Areas for further improvement are listed. (1 figure) (R.W.R.)

36207 (ANL/HEP-7208(Vol.3), pp 725-9) EXPERIENCE WITH POLLY AND 12-FOOT BC FILM. Engelmann, R. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Work in progress to enable processing pictures from the ANL 12-ft bubble chamber with the automatic film processing device POLLY is reported. A new version of POLLY, POLLY III, is under development. The status of work on the existing software package for POLLY II and the problems encountered in automatic processing are discussed. A processing rate of 50 events/hr for film from the 12-ft bubble chamber appears feasible for POLLY III. (R.W.R.)

36208 (ANL/HEP-7208(Vol.3), pp 730-45) PEPR MEASUREMENTS OF ARGONNE 12' HBC FILM. Mott, J. E.; Alyea, E. D.; Galloway, K. F.; Mercer, R. A.; Martin, H. J. (Indiana Univ., Bloomington). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Use of the present PEPR system at Indiana Univ. (with slight modification) to measure film from the ANL 12-ft bubble chamber is discussed. A general description of the hardware is given, and then the measurement of a specific piece of film is examined in some detail. It is felt that with suitable software changes 20 to 40 events/hr could be measured by an operator on line, but that expectations for measuring without a human operator look bleak. (13 figures) (R.W.R.)

36209 (ANL/HEP-7208(Vol.3), pp 746-52) POSSIBLE CHANGES TO THE ORIENTATION OF THE 12-FT. CHAMBER CAMERAS. Genens, L. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

In order to cover the entire chamber and to allow for the possibility of rotating the cameras, a positionable cartridge and camera system was designed. This system and associated problems are described. (4 figures) (R.W.R.)

36210 (ANL/HEP-7208(Vol.3), pp 753-62) MEASURING AND SCANNING EQUIPMENT FOR THE ARGONNE 12-FOOT BUBBLE CHAMBER. Burnstein, R. A.; McComas, J. G.; Swanson, D. L. (Illinois Inst. of Tech., Chicago). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The design and performance of low-cost equipment at Illinois Inst. of Tech. for measuring and scanning film from the ANL 12-ft bubble chamber are discussed. (8 figures) (R.W.R.)

36211 (ANL/HEP–7208(Vol.3), pp 763-5) 12-FT. SCANNING AND MEASURING AT NOTRE DAME. Kenney, V. P. (Notre Dame Univ., Ind.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Results of scanning film taken in a study of inclusive interactions with the ANL 12-ft bubble chamber by means of (for the most part) existing conventional scanning equipment are discussed. It was found that conventional 10X magnification is generally satisfactory, dual magnification is sufficiently useful that it is worth providing, and pictures from the 12-ft chamber are generally easy to scan. (1 figure) (R.W.R.)

36212 (ANL/HEP–7208(Vol.3), pp 766-74) ANL PLANS FOR SCANNING MACHINES. Blair, H. (Argonne National Lab., Ill.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The scanning system at ANL for the 12-ft bubble chamber is discussed. It contains four film transports and provides two magnifications; a grid, superimposed on each view so that the optical chamber distortions could be built into the scanning table, was designed but is not yet implemented. The cost of producing one of these machines is about $65,000. (7 figures) (R.W.R.)

36213 (ANL/HEP–7208(Vol.3), pp 775-84) SCAN TABLES: CERN PLANS FOR BEBC. Robinson, C. J. (Glasgow Univ. (Scotland)). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
The principal features of the cameras and scan tables for the Big European Bubble Chamber are listed. The specifications for the BEBC scan table are included as an appendix. (2 figures) (R.W.R.)

36214 (ANL/HEP–7208(Vol.3), pp 949-56) TRACK-SENSITIVE TARGETS AND NEON–HYDROGEN MIXTURES: A SURVEY. Kenney, V. P. (Notre Dame Univ., Ind.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Some of the advantages and disadvantages of using hydrogen and deuterium track-sensitive targets in bubble chambers filled with hydrogen—neon mixtures are discussed. (4 figures) (R.W.R.)

36215 (ANL/HEP–7208(Vol.3), pp 957-9) RECENT BNL EXPERIENCE WITH TST. Huson, F. R.; Miller, W.; Pechar, R.; Prodell, A.; Worwetz, H. (Brookhaven National Lab., Upton, N. Y.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A test of a track-sensitive target in the BNL 30-in. bubble chamber is described. Both chamber and target were filled with hydrogen. The target was operated for some time with temperature and pressure differences between it and the chamber. (3 figures) (R.W.R.)

36216 (ANL/HEP–7208(Vol.3), pp 960-5) DISCUSSION OF RUTHERFORD, CERN, AND ANL PLANS FOR TRACK SENSITIVE TARGETS. Jaeger, K. (Argonne National Lab., Ill.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The design of track-sensitive targets for ANL, CERN, and Rutherford High-Energy Laboratory is briefly reviewed. Test results for the Rutherford target are also given. (1 figure) (R.W.R.)

36217 (ANL/HEP–7208(Vol.3), pp 966-70) USE OF THE 12-FT. CHAMBER WITH H–Ne MIXTURES. Carmony, D. Duane (Purdue Univ., Lafayette, Ind.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The suitability of the 12-ft chamber for the study of reactions with two or more neutral particles is discussed. A number of interesting experiments in the range 2 to 10 GeV/c could be done at the ZGS, but the 12-ft chamber will be only marginal unless a track-sensitive target containing D or H is installed. (4 figures, 1 table) (R.W.R.)

36218 (ANL/HEP–7208(Vol.3), pp 971-7) EXPERIENCE WITH GAMMA RAYS AND CHARGED TRACKS IN A HEAVY LIQUID BUBBLE CHAMBER EXPERIMENT. Dombeck, Thomas (Argonne National Lab., Ill.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The topics of track errors, the determination of gamma momenta, and scanning losses of gamma rays in a heavy-liquid bubble chamber are discussed from the point of view of relevance to experiments in neon—hydrogen mixtures in the 12-ft chamber. The errors on charged tracks in a heavy liquid have contributions from measurement error and multiple scattering. An optimum track length exists where the angle errors are minimized, but this is not so for momentum errors. Since more tracks will stop in a heavier liquid, momentum can be determined from range. Electrons lose a significant amount of energy by bremsstrahlung; therefore, the measured momentum of electrons will be systematically underestimated unless a correction is made for this radiative loss. Scanning losses can be very important for final states involving many gamma rays. The distribution of gamma rays as a function of azimuthal angle showed a loss when gammas went directly toward or away from the chamber cameras. The overall loss was observed to be 12%; however, for certain final states the loss was as large as a factor of two. (3 figures, 2 tables) (R.W.R.)

36219 (ANL/HEP–7208(Vol.3), pp 998-1005) GAMMA PHYSICS WITH SPARK CHAMBERS. Kalogeropoulos, T. (Syracuse Univ., N. Y.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The design of a 4π γ detector around a liquid hydrogen target is described; the primary objective was the study of $\bar{p} + p \rightarrow$ neutrals at rest. Because of the geometrical simplicity of the configuration, it is possible to record an event with one camera, get 90° stereo, and recognize events almost as easily as in a bubble chamber. The $\bar{p} + p$ data are discussed with emphasis on some of the technical aspects. (6 figures) (R.W.R.)

36220 (DESY–72/16) ON THE MOVEMENT OF BUBBLES IN A MEDIUM-SIZED BUBBLE CHAMBER. Harigel, G.; Horlitz, G.; Wolff, S. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1972. 67p. Dep. NTIS (U. S. Sales Only).
Bubble movement was measured in the 85 cm hydrogen bubble chamber at DESY as a function of flash delay, liquid temperature, and static pressure. The displacement of bubbles, photographed with 1 : 1 magnification bright field optics could be explained by a superposition of three effects: (1) movement of the liquid due to its compressibility, (2) inertia forces, and (3) buoyancy forces. (auth)

36221 (JINR–P13-6374) SEPARATING PLATE MADE OF FIBERGLASS FOR BUBBLE CHAMBER. Kruglyakova, V. I.; Mal'kov, V. M.; Polakh, I.; Slepneva, L. V.; Filippov, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).
The technique of manufacturing a fiberglass separating plate is described. A comparison is made of experimental and calculated values of tension in the separating plate depending on the tensile stress. The disagreement between these values (for some areas of the separating plate) is, in general, due to the simplifications in the mode of calculation of the tested samples. The data presented speak in favor of the possibility of calculating and manufacturing fiberglass separating plates for cryogenic bubble chambers. (auth)

36222 USE OF NEON FLASH TUBES AT HIGH REPETITION RATES. Holroyd, F. W.; Breare, J. M. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 100: No. 3, 429-32(1972).

When flash tubes are used at high repetition rates, their efficiency at long time delays between the passage of the ionizing particle and the application of the high-voltage pulse decreases faster than theoretical predictions. An explanation of the phenomena is proposed in terms of clearing fields resulting from charges deposited on the inside glass surface by previous discharges. Methods of avoiding the build-up of such clearing fields are discussed. (auth)

36223 MULTIWIRE PROPORTIONAL CHAMBERS IN A π^--e EXPERIMENT AT 50 GeV/c. Zanevskii, Yu. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Nigmanov, T. S.; Peshekhonov, V. D.; (and others). Nucl. Instrum. Methods; 100: No. 3, 481-4 (1972).
The work was performed at the Institute of High Energy Physics (Serpukhov) during the preparing and performing of the π—e scattering experiment, in which physicists from the University of California and Joint Institute for Nuclear Research took part by the invitation of IHEP (Serpukhov). Characteristics of proportional chambers used in the experiment are described. Utilization of these chambers together with magnetostrictive chambers for beam monitoring and event reconstruction is shown. (8 figures) (auth)

36224 SOME PROPERTIES OF MULTIWIRE PROPORTIONAL CHAMBERS. Peshekhonov, V. D.; Zanevskii, Yu. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 100: No. 3, 505-8(1972).

The construction and properties (obtained under laboratory conditions) of proportional chambers with 2 and 3 mm wire spacing are described. The sensitive area of the chamber is 150×150 mm^2. These chambers were successfully used for selective triggering of the wire spark chamber system in the π^- p elastic scattering experiment at the Institute of High Energy Physics (Serpukhov). (8 figures) (auth)

36225 CYLINDRICAL WIDE GAP AND STREAMER CHAMBERS. Risk, W. S. (Univ. of Maryland, College Park). Nucl. Instrum. Methods; 100: No. 3, 509-14(1972).

Cylindrical chambers as long as 96 in. with a 3 in. gap turned on a 6 in. radius were built and operated successfully as wide gap chambers. Made from 3.0-mil-thick Mylar toroidal gas cells surrounded with appropriate conducting electrodes, these chambers are completely self-supporting upon inflation with helium or spark chamber-grade neon gas. Without massive internal or external supports, their large solid angle acceptance, high visibility, and low mass make them the ultimate in simplicity. Due to the nonlinear field of the cylindrical geometry, however, attempts to operate the chamber in the streamer mode failed to produce streamers useful for precision measurements of particle trajectories. Details of construction, operation, and response of the chamber are included along with photographs of particle tracks observed in the chambers. Additional photographs are available in W. S. Risk, University of Maryland Technical Report No. 72-030. Development work on these chambers was terminated in February of 1970. (5 figures) (auth)

36226 HIGH VOLTAGE READ-OUT FOR MULTIWIRE PROPORTIONAL CHAMBERS. Fischer, G.; Plch, J. (CERN, Geneva). Nucl. Instrum. Methods; 100: No. 3, 515-23(1972).

Some basic properties of the digital readout from strips on a high-voltage electrode of multiwire proportional chambers are described. The efficiency plateau, time spectra, and space resolution were measured. It is shown that there is a certain limit of space resolution caused by the broad space distribution of induced charge and by cross talk among the hv channels. (17 figures) (auth)

36227 POWDER COUNTER, A NEW DETECTOR OF HIGH ENERGY PARTICLES. Linney, A.; Peters, B. (Danish Space Research Inst., Lyngby). Nucl. Instrum. Methods; 100: No. 3, 545-7(1972).

Fine powders with grain size small compared to the wavelengths in the optical region can be used to produce Cherenkov radiators with adjustable velocity cutoffs. By compressing such powders to various densities disks were produced with refractive indices between 1.05 and 1.20, a region not covered by other suitable solids or liquids. Preliminary experiments indicate that the yield of Cherenkov light, produced by relativistic particles traversing this material, corresponds roughly to the expected value. (6 figures) (auth)

36228 PERFORMANCE OF A BANK OF FOUR 7 FT STREAMER CHAMBERS. Crouch, J. H.; Risk, W. S. (Univ. of Maryland, College Park). Nucl. Instrum. Methods; 100: No. 3, 525-32(1972).

A bank of four 3 in. gap × 12 in. wide × 7 ft long streamer chambers surrounding a one-atmosphere hydrogen gas target used in an experiment to measure the threshold cross section for the reaction $\pi^+p \to \pi^+\pi^+n$ is described. Details of construction and operation are presented, and photographs of representative tracks are included. This report covers research performed to September 1, 1971, including operation of the chambers during a three-week run of the experiment in August 1971. A more complete set of photographs illustrating chamber response is available in J. H. Crouch and W. S. Risk, University of Maryland Technical Report No. 72-032. (6 figures, 1 table) (auth)

36229 IN-FLIGHT PION BEAM FLUX MONITOR. Coulson, L. V. (Rice Univ., Houston, Tex.); Fletcher, C. R.; Hungerford, E. V.; (and others). Nucl. Instrum. Methods; 101: No. 2, 247-51(1972).

An absolute pion flux monitor has been developed which employs the detection of muons from pion decay with multiwire proportional counters. The system also provides a measure of the pion momentum, the momentum resolution, and spatial distribution of the pion beam, and is useful in the energy range below 300 MeV. (auth)

36230 SYSTEM OF CYLINDRICAL WIRE SPARK CHAMBERS. Niebergall, F. (CERN, Geneva); Regler, M.; Winter, K.; (and others). Nucl. Instrum. Methods; 101: No. 2, 321-6(1972).

A system of cylindrical wire spark chambers with ferrite core memory has been used in an experiment on rare decay modes of K^0. The state K^0 is produced in the reaction $K^+p \to K^0p\pi^+$. The direction of the recoiling proton and pion are measured in a large solid angle in the system described. (auth)

36231 PLASTIC THRESHOLD CHERENKOV DETECTORS WITH WAVELENGTH SHIFTER AND QUENCHER. Sacharidis, E. J. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods; 101: No. 2, 327-41(1972).

Tests on the threshold behavior of plastic Cherenkov radiators containing wavelength shifter and quencher are described and discussed. It is shown that they lead to improved photoelectron yield combined with angular uniformity and low scintillation level above 0.500 GeV/c. (auth)

36232 HIGH-VOLTAGE PULSE GENERATOR FOR SPARK CHAMBERS IN SPACE. Baldwin, A.; Lund, T.; Madey, R. (Kent State Univ., Ohio). Nucl. Instrum. Methods; 101: No. 2, 363-74(1972).

The design and performance characteristics of a high-voltage pulse generator for use with spark chambers in space are described. In order to minimize power consumption, the pulse generator is designed around a cold-cathode thyratron. The complete pulse generator consists of a thyratron pulser and an avalanche-transistor switching circuit. Included also is a simple means for applying a steady clearing field to the spark chambers. The pulse generator can be triggered at uniform repetition rates up to about 100 per second to produce negative pulses with a peak amplitude of typically 2 kV. The observed rise-time is about 5 ns with only stray capacitance loading. It increases with the capacitance loading introduced by a spark-chamber at the output of the pulser. The total delay-time from the input trigger pulse to the output pulse is about 140 ns. The pulse decays exponentially with a time constant of the order of a microsecond. Pulse amplitudes up to 4 kV are possible with the particular thyratron selected for this application. The particular high-voltage pulse generator described in this paper provides 2100 V to three spark-chambers each with a capacitance of 150 pF. The power consumption of this generator with a single power supply is typically 0.5 W at low pulse repetition rates, 1.2 W at a pulse repetition rate of 20 per second, and 3.3 W at 100 pulses per second; alternatively, the power consumption of a pulse generator with multiple power supplies may be reduced to typically 0.1 W at low repetition rates, 0.8 W at 20 pulses per second and 2.9 W at 100 pulses per second. In laboratory tests, several krytrons have been pulsed from 275 to 385 million times before failure. (auth)

36233 LSI MOST MEMORY IN DIGITAL DATA OF BUBBLE CHAMBER PHOTOGRAMS TRANSMISSION SYSTEM. Zecchin, G. (Istituto di Fisica, Trieste, Italy). Nucl. Instrum. Methods; 101: No. 2, 375-81(1972).

A system particularly suitable for the on-line transmission of data derived from semi-automatic tables has been developed to measure the events of high energy particles on bubble chamber photograms. The transmission is done by radio. (auth)

36234 SPARK CHAMBER WITH IMPROVED TIME RESOLUTION. Moromisato, J.; Garelick, D. (Northeastern Univ., Boston). Nucl. Instrum. Methods; 101: No. 2, 397-9(1972).

A new type of particle detector, similar in construction and spatial resolution to a conventional spark chamber, but with a time resolution ability which is approximately five times better than that of a conventional spark chamber is described. (auth)

36235 HYBRID CHAMBER: A PROPORTIONAL CHAMBER WITH GATED SPARK READOUT. Fischer, J.; Shibata, S. (Brookhaven National Lab., Upton, N. Y.). Nucl. Instrum. Methods; 101: No. 2, 401-4(1972).

The hybrid chamber combines the fast resolving time ($\simeq$75 ns) of the multiwire proportional chamber with the event selectivity, spatial resolution ($\simeq$0.3 mm), and "inexpensive" readout of the spark chamber. Some characteristics are described. (auth)

36236 STUDIES OF MUONS IN THE TeV ENERGY RANGE BY MEANS OF EMULSION CHAMBERS. Baradzei, L. T.; Kanevskaya, E. A.; Smorodin, Yu. A.; Solov'ev, M. V. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 33-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

There is a possibility to use emulsion chambers with X-ray films for investigating the energy and angular distributions of muons in the TeV energy range. The results of the first underground exposure of the chambers from April to December 1968 are given. The rate of detecting opaque spots on films is about 3 m^{-2} year^{-1}. The distribution of the spots according to their optical density is calculated. The experimental data concerning the spectra of the opaque spots are in agreement with the vertical muon spectrum in the 2 to 7 TeV energy regions. (auth)

36237 STUDY OF HIGH-ENERGY MUONS BY MEANS OF EMULSION CHAMBERS. Cherdyntseva, K. V.; Ivanenko, I. P.; Khristiansen, G. B.; (and others) (Moscow State Univ. Lebedev

Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 81-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An installation for determining the energy spectrum and angular distribution of μ-mesons with energies above 10^{12} eV is described. It consists of emulsion chambers containing a series of X-ray films and lead layers. Preliminary results of the determination of particle energies are discussed. (auth)

36238 UNDERGROUND ANTICOINCIDENCE EXPERIMENT. Barton, J. C.; Pourgourides, C. M. (Northern Polytechnic, London). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 239-45 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A large anticoincidence apparatus has been set up in the Holborn underground laboratory at a depth of 60 hg cm^{-2}. A cylindrical space, of diameter 45 cm and height 120 cm, is surrounded by an annular liquid scintillation counter, which is also extended to cover the top. The apparatus is inserted from underneath on a rising platform, which includes a disc of scintillator to complete the screen. Experiments using single scintillation counters and counter telescopes have shown that most anticoincidence events are due to photons, and that these are likely to be secondary to fast muons passing outside the screen. The "leakage" of charged particles into the screened volume is not much greater than 0.001%. (auth)

36239 STUDY OF LARGE-AREA SCINTILLATION COUNTERS. Alper, S.; Frohlich, A. (Tel Aviv Univ., Israel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 381-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Two liquid scintillation counters, 1 m^2 and 0.5 m^2 in area, are described, which utilize medicinal paraffin oil as the scintillator solvent. The scintillations produced by cosmic ray muons are collected by total internal reflection and by a system of plane mirrors. The energy resolution, uniformity of response, and stability using a single photomultiplier have been measured and found to be equal to, or better than, those reported for similar counters elsewhere. The influences of the output pulse parameters on performance are discussed and it is shown that under certain conditions the signal to noise ratio can be improved by integrating the output pulse rather than just analyzing pulse amplitudes. (auth)

36240 HIGH-ENERGY PRIMARY COSMIC-RAY PROGRAM OF GODDARD SPACE FLIGHT CENTER. Ormes, J. F.; Balasubrahmanyan, V. K. (Goddard Space Flight Center, Greenbelt, Md.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 397-402(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A status report on the high energy program of the Goddard Cosmic Ray Group is presented. This program attempts to determine the charge composition of the primary cosmic radiation in the energy range 10^{10} eV to 10^{14} eV with a series of experiments carried in balloons and satellites. Particle charge is identified using a four element telescope containing two plastic scintillators, a lucite Cherenkov detector and a CsI(Na) mosaic, each of which is 50 cm × 50 cm. It has a collection factor of 2500 cm^2 sr. Uniformity of response and the resolution comparable to that of much smaller detectors is obtained through use of digitized wire spark chambers for recording particle trajectories. It also allows for identification of multiple particle background events. Electron energy is measured through the development of the cascade shower in a tungsten scintillator sandwich 12 radiation lengths thick. The energy measurement of protons and heavier nuclei is carried out with a total ionization spectrometer in which the loss is sampled at every 1.5 radiation lengths. A successful balloon flight of 30 hours duration was achieved at 5 GV cut-off on April 28, 1969. The operating characteristics of the instrument are discussed and future flight plans are outlined. (auth)

36241 DESIGN AND PERFORMANCE OF A LARGE-AREA WATER CHERENKOV COUNTER. Ashton, F.; Kelly, G. N. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 417-25(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The performance of a 1.29 m^2 area water Cherenkov counter which acts as a highly efficient selector of low velocity ($\beta < 0.8$) particles is described. Such counters are useful in selecting heavy mass particles at a low flux level in a high background of muons, pions, and protons. (auth)

36242 MEASUREMENTS OF COSMIC-RAY RIGIDITY SPECTRA USING A SUPERCONDUCTING MAGNET. Golden, R. L. (Manned Spacecraft Center, Houston, Tex.); Deney, C. L.; Heckman, H. H. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 433-6(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Cosmic ray rigidities well above geomagnetic cutoff are being measured using emulsion plates exposed in a magnetic field supplied by a superconducting magnet. The balloon-borne apparatus, with a 50 cm^2 sr geometry factor, was flown at 136,000 feet for 10.4 hours from Palestine, Texas, in June 1969. Data obtained from the flight are being used to measure the charge composition and rigidity spectra of multiply charged nuclei. The rigidity resolution is expected to be 10% at 5 GeV and 50% at 350 GeV. The apparatus is described in detail and the rigidity determination techniques are discussed. (auth)

36243 TECHNIQUES FOR RAPID TRACK ANALYSIS IN NUCLEAR RESEARCH EMULSIONS. O'Dell, F. W.; Stiller, B. (Naval Research Lab., Washington, D. C.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 437-41(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Scanning for tracks in nuclear research emulsions, and subsequent analysis of these tracks, requires great time and effort when using this technique for cosmic ray research. A system (HAREM—High Accuracy Readout Equipment for Microscopes) has been designed and constructed with which one can semiautomatically record X, Y and Z coordinates from several microscopes on a single magnetic tape recorder. Coordinates are recorded with a precision of 2 microns. The coordinate position of the microscope stage is also visually displayed. The system is operating with 6 Leitz Ortholux microscopes. Transcription errors of coordinates have been eliminated and scanning speed has been doubled. In order to determine the charge of a particle which has produced a track in an emulsion, a variety of so-called ionization measurements must be made. Considerable improvement in the accuracy and speed of such determinations has been achieved by the design and construction of a semiautomatic measuring system (Track Analyzing Photomultiplier—TRAP), using a photomultiplier to "look" at the tracks. Its "vision" is electronically processed, and the results are recorded on paper tape for subsequent computer analysis. (auth)

36244 CURRENT-LIMITED SPARK CHAMBERS. Bull, R. M.; Coates, D. W.; Milne, W. J.; (and others) (Univ. of Nottingham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 465-72(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Current limited spark chambers have been investigated both because of their inherent interest and because they are required for a muon interaction experiment currently under construction at Nottingham. Several types of chambers have been used and a discussion of their characteristics is given. The chambers have clear potentialities as cheap, multiply efficient detectors; however, their mechanism is not completely understood and some anomalies of the efficiency-delay time relationship are discussed. (auth)

36245 PROPERTIES OF MULTITRACK SEALED SPARK CHAMBERS. Stubbs, R. J.; Breare, J. M. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 473-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The efficiency of sealed spark chambers having glass covered electrodes has been measured as a function of the delay between the passage of the cosmic ray particle and the application of the high voltage pulse. It was found that the shape of the efficiency curve depends on the rate at which the chamber is operated. It is suggested that a clearing field, whose origin is photo-electrons released by uv light from the sparks accounts for the shape of the curves and that this mechanism is probably responsible for spurious low efficiencies also observed in flash tubes under certain operating conditions. (auth)

36246 MAIN CHARACTERISTICS AND POSSIBILITIES OF DISCHARGE CLOUD CHAMBERS. Dzhavrishvili, A. K.; Mandzhavidze, Z. Sh.; Roinishvili, V. N. (Inst. of Physics, Tbilisi, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 479-82(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The characteristics of a new detector, called discharge cloud chamber, of charged particles were studied. It was shown that the chamber operates well with various filling gases, such as Ne, He, Ar and H_2. The operational characteristics have been compared with those of other particle detectors. Various possibilities of using the discharge cloud chamber to study cosmic ray interactions are discussed. (auth)

36247 NEW POSSIBILITIES OF THE TSKHRA–TSKARO INSTALLATION. Berdzenishvili, O. L.; Garibashvili, D. I.; Gromov, Yu. A.; (and others) (Inst. of Physics, Tbilisi, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 483-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Some improvements made recently in the Tskhra–Tskaro installation are described. Physical parameters of the installation with new measuring possibilities are given including 1) determination of the direction of a charged primary particle; 2) measurements of the coefficients of the energy transfer to π^0-mesons; and 3) use of spark chambers in the installation. Some preliminary physical results are given. (auth)

36248 MULTILAYERED PROPORTIONAL COUNTERS FOR IDENTIFICATION OF COSMIC-RAY PROTONS AND PIONS. Bashindzhagyan, G. L.; Vasil'ev, V. P.; Murzin, V. S.; Sarycheva, L. I.; Sinev, N. B. (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 487-90(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The possibility to distinguish pions from protons in cosmic radiation at energies of $\approx$200 GeV is studied. Experimental ionization distributions obtained by means of a proportional counter consisting of a single layer were used to determine the efficiency of proportional counters consisting of many layers in distinguishing pions from protons. If a beam consisting of two thirds protons and one third pions falls on counters consisting of 10, 20, and 30 layers, an admixture of 42%, 31%, and 23% respectively of proton events may be expected among the events classified as pion events, and an admixture of 15%, 11%, and 9% of pion events may be expected among the events classified as proton events. (auth)

36249 NEW MUON SCINTILLATION MONITOR AT LINDAU. Kisselbach, V. J. (Max-Planck-Institut fuer Stratosphaerenphysik, Lindau, Ger.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 491-2(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A scintillation device to record cosmic ray muons has been constructed at the Max Planck Institute for Aeronomy, Institute for Stratosphere Physics, Lindau, G.F.R. The device consists of four circular plastic disc-scintillators, 1 m in diameter viewed by 5 inch photomultipliers. During the construction of the monitor the characteristics of the electronic detection and coincidence selection system were closely investigated. It was determined that high spectral fidelity is an important criterion for precision coincidence recordings. (auth)

36250 HIGH-RESOLUTION DETECTOR OF NUCLEAR-ACTIVE PARTICLES. Baruch, J. E. F.; Brooke, G.; Kellermann, E. W. (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 493-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

It is suggested that a 4 m^2 2-layer detector containing proportional counters, of fairly small diameter and good energy resolution, with suitable absorbers can be useful in examining nuclear-active particles (NAP's) unaccompanied and in association with showers up to 10^6 particles. Comparison of the performance of this type of detector with an 8-layer detector indicates that a 2-layer detector will allow the determination of certain average properties of NAP's of interest. (auth)

36251 ENERGY LOSSES WHICH ARE NOT MEASURED BY IONIZATION SPECTROMETERS. Jones, W. V. (Louisiana State Univ., Baton Rouge. Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 505-12(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The mean and standard deviation of the fraction of the total primary energy which cannot be measured by an ionization spectrometer are given as a function of primary energy and depth in the spectrometer. This dependence is given for three absorbers (glass, iron, and tungsten) over the primary energy range 10 to 1000 GeV. The unmeasured energy loss is taken to be the sum of two components: (i) the total energy in nuclear disintegrations occurring in a given depth in the spectrometer and (ii) the energy content of the cascade particles passing beyond that depth. These components have been computed by a one-dimensional Monte Carlo simulation of the nuclear-electromagnetic cascade. The cascade simulation has been compared with measurements made with a small iron-absorber spectrometer with 10, 20, and 30 GeV protons from an accelerator. The simulation was then extended up to the higher energies and to the different absorbers. (auth)

36252 PROPERTIES OF AN IONIZATION SPECTROMETER EXPOSED TO 10-, 20.5-, AND 28-GeV/c MACHINE-ACCELERATED PROTONS. Jones, W. V. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger.); Pinkau, K.; Pollvogt, U.; Schmidt, W. K. H.; Huggett, R. W. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 521-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An ionization spectrometer has been employed in several successful balloon flights in combination with spark chambers and different target materials to study high energy cosmic rays. The same spectrometer was exposed to 10, 20.5, and 28 GeV/c protons from the Alternating Gradient Synchrotron (AGS) at Brookhaven in order to study its response and be able to calibrate it at these energies. Some results of these calibration measurements are reported. These include the accuracy of energy measurement, the inelastic interaction cross section for protons in iron, and the inelasticity of the interactions of protons with carbon, iron, and lead nuclei. (auth)

36253 DURGAPUR COSMIC-RAY SPECTROGRAPH. Nandi, B. C.; Sinha, M. S. (Regional Engineering Coll., Durgapur, India). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 529-33(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A vertical double magnet cosmic ray spectrograph has been installed at Durgapur for the measurement of momentum spectrum and charge ratio of cosmic ray muons at sea level and 12° N geomagnetic latitude. Solid iron magnets used for the deflection of charged particles are similar to those used by the Durham and Nottingham groups. The stability and uniformity of the magnetic induction have been studied and found to be satisfactory. The acceptance solid angle and the m.d.m. of the spectrograph are 11.7 cm^2 sr and 1200 GeV/c, respectively. The ratio of r.m.s. scattering deflection to that of magnetic deflection is 0.17. (auth)

36254 MAGNET SPECTROGRAPH FOR PRIMARY COSMIC-RAY STUDIES. Cowsik, R.; Damle, S. V.; Pal, Y.; (and others) (Tata Inst. of Fundamental Research, Bombay). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 535-40(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A magnet spectrograph for balloon-borne high energy cosmic ray experiments has been built and flight-tested. The instrument uses a large permanent magnet, along with wide gap spark chambers and accurately aligned photo-plate detectors for accurate measurement of the particle trajectory. The instrument is capable of measuring particle rigidities up to 150 GeV. In the near future it is hoped to use this for measuring the energy spectra of primary electrons, helium nuclei and heavy nuclei up to ~100 GeV. A search for high energy anti-helium nuclei will also be made. (auth)

36255 DIGITISATION OF HIGH-PRESSURE NEON FLASH TUBES. Ayre, C. A.; Thompson, M. G. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 541-6(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A new technique for the digitization of the information from neon flash tubes is described. By placing a simple probe against the front of the flash tube an electrical pulse can be detected whenever the flash tube discharges. This eliminates the necessity of an optical device looking at the flash tube and is thus cheaper and more reliable. Typically a pulse of 0.2 to 0.3 kV can be detected with the simple probe and by a suitable circuit this can be reduced and shaped as required. Some studies of large diameter low pressure tubes have already been reported and the extension of the technique to small diameter, high pressure tubes of the type to be used in the Durham 5000 GeV/c spectrograph is reported. Further data on large diameter tubes are presented and the characteristics of tubes of both diameters compared. (auth)

36256 DURHAM 5000-GeV/c SPECTROGRAPH: MARS. Ayre, C. A.; Breare, J. M.; Holroyd, F. W.; (and others) (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 547-51(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A description is given of a solid iron spectrograph (''MARS''—magnetic automated research spectrograph) which is being constructed to measure the muon spectrum up to momenta in excess of 5000 GeV/c. The instrument is automated and connected on-line to an IBM 1130 computer. It will operate initially in the vertical direction and subsequently at large zenith angles. (auth)

36257 DESIGN THEORY FOR MULTIPLATE SPARK CHAMBERS USED AS TARGETS. Verma, S. D. (Louisiana State Univ., Baton Rouge). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 559-63(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A probability calculation for a design of multiplate spark chambers used as targets in high energy particle and cosmic ray physics experiments is presented. The thickness of the plates and the total thickness of the target are optimized to obtain the largest number of nuclear interactions free of secondary interactions in the target. The choice of various materials for the plates is briefly discussed. (auth)

36258 APPARATUS FOR MEASURING COSMIC-RAY SPECTRA AT DIFFERENT ALTITUDES IN THE ATMOSPHERE. Allkofer, O. C.; Knoblich, P. (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 565-70(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An apparatus consisting of a magnet spectrograph using spark chambers and a calorimeter has been constructed for cosmic ray measurements referring to momentum spectra and particle identification at different altitudes. The apparatus enables momentum and sign of charge to be determined by means of magnetic deflection in the spectrometer, as well as range and energy loss by means of the calorimeter. Range is measured by means of a scintillator-absorber sandwich, energy loss is measured by ionization, and nuclear interactions are detected by pulse-height analysis in the scintillation counters. The equipment was tested by sea level measurements. The problem of protecting pulse-height analysis against spark chamber noise was solved by timing. (auth)

36259 VIDICON SYSTEM FOR DIGITALISING FLASH-TUBE INFORMATION. Harrison, D. J.; Rastin, B. C. (Univ. of Nottingham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 571-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An instrument based on a television channel employing a vidicon tube as the sensing element has been designed and constructed to record automatically the trajectories of particles passing through an array of neon flash tubes. Although at present the device has been designed primarily to work in conjunction with a magnetic spectrometer, it is capable of modification to record multiple particles through an array, for example in Extensive Air Shower work, or trajectories of particles in spark chambers. (auth)

36260 USE OF PROPORTIONAL COUNTERS FOR DETECTING THE MESON COMPONENT OF COSMIC RAYS. Blokh, Ya. L.; Dmitriev, A. B.; Eroshenko, E. A.; Leonov, V. Kh.; Frantsuz, E. T. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propation, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 579-83(1970).

From eleventh international conference on cosmic rays; Budapest Hungary (25 Aug 1969).

At present the design of superinstruments for detecting the hard component of cosmic radiation requires a critical approach to the choice of ionizing radiation detectors. The use of proportional counters in such installations has some advantages as compared with Geiger counters: practically infinite life time and vanishingly small dead time which makes possible to reduce to zero the counting loss and thereby to exclude some part of the spurious variations. Some characteristics of the large proportional counters SGM-14 of Soviet manufacture, filled with cyclohexane have been investigated. The efficiency of the counters as well as the temperature coefficients in the most probable temperature range has been studied together with the time of delay of the onset of the discharge with respect to the moment of passage of the ionizing particle through the counter. (auth)

36261 SPECTROMETER FOR INVESTIGATING THE MUON SPECTRUM AND CHARGE RATIO UP TO MOMENTUM OF 3×10^{12} eV/c. Cousins, J.; Harrison, D. J.; Hoque, M. T.; Rastin, B. C. (Univ. of Nottingham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 585-91(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The main features of a solid iron magnet spectrometer which is capable of a momentum measurement up to 3×10^{12} eV/c are described. The instrument utilizes neon flash tubes to define the trajectory of the muon and an automatic data handling system to allow the acceptance of a high flux of particles. This apparatus has been arranged to investigate the muon spectrum and charge ratio in the vertical direction. (auth)

36262 SLAC–LRL MUON SPECTROMETER. De Coster, R. (Univ. of California, Berkeley); Flatte, S.; Stevenson, M. L.; Toner, W. T.; Zipf, T. F. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 593(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

1.6×10^6 photographs of sea level muons with zenith angles between 45° and 90° have been taken at SLAC in the high energy muon spectrometer whose properties are summarized. Analysis of the data is in progress. A few hundred events with momenta in excess of 1000 GeV/c are expected. The MDM of the apparatus is of the order of 3000 GeV/c. The total "live time" of the run was 850 hours, and the solid-angle area product 945 cm^2 sr. (auth)

36263 CHOICE OF THE PARAMETERS OF BEAM INSERTION INTO BUBBLE CHAMBERS. Gerdyukov, L. N.; Danil'chenko, I. A.; Kuznetsov, E. P.; Samoilov, A. V. (Inst. of High Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1015-18(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 61-3(Jul-Aug 1971).

A method is described for choosing the coordinate and angle of particle-beam entry into large bubble chambers. (auth)

36264 DETERMINATION OF THE NATURE OF CHARGED PARTICLES FROM THE DELTA-ELECTRONS IN A HYDROGEN BUBBLE CHAMBER. Boos, E. G.; Moisenko, A. M.; San'ko, L. A.; Takibaev, Zh. S.; Temiraliev, T. T. (Nuclear Physics Inst., Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1019-21(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 64-6(Jul-Aug 1971).

The results of applying a new method of identifying high-energy charged particles by means of δ-electrons are discussed. δ-Electrons were recorded on the secondary tracks resulting from four-prong pp-interactions in an 81-cm hydrogen bubble chamber for a primary momentum of 10 GeV/c. The efficiency of the method is 4% of the total number of secondary particles; in principle it provides the possibility of determining the nature of the particles in the range of momenta above 2 GeV/c where identification by the method of measuring ionization losses is practically impossible. (auth)

36265 IDENTIFICATION OF SECONDARY PARTICLES FROM THE IONIZATION LOSSES IN A HYDROGEN BUBBLE CHAMBER. San'ko, L. A.; Takibaev, Zh. S.; Boos, E. G.; (and others) (Nuclear Physics Inst., Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1022-4 (Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 67-9(Jul-Aug 1971).

The results are presented of the identification of secondary charged particles formed in the interaction between protons having a momentum of 10 GeV/c in an 81-cm hydrogen bubble chamber. It was shown that the average–break-length method may be used for unique determination of the nature of 30% of all the positive particles in the momentum interval $1 < P_i < 2$ GeV/c. (auth)

36266 MEASUREMENT OF THE IONIZATION LOSSES OF PARTICLES IN A BUBBLE CHAMBER USING A TELEVISION MEASUREMENT SEMIAUTOMATON. Takibaev, Zh. S.; Boos, E. G.; San'ko, L. A.; (and others) (Inst. of High-Energy Physics, Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1025-7(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 69-72(Jul-Aug 1971).

The initial results of measuring the bubble density on the tracks of particles from pp-interactions at a momentum of 19.1 GeV/c in the CERN two-meter hydrogen bubble chamber are presented. (auth)

36267 TARGET SPARK CHAMBER HAVING A LARGE DISCHARGE GAP. Mikhailov, V. A.; Il'in, N. S. (Physics Inst., Tbilisi, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1028-9(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 72-3(Jul-Aug 1971).

Test results on a wide-gap spark chamber having electrodes made of aluminum foil which is placed between the plates of the nonconducting target substance are discussed. (auth)

36268 DEVICE FOR FILLING SPARK CHAMBERS AUTOMATICALLY. Avakyan, K. M.; Aivazyan, R. B.; Matevosyan, E. M. (Erevan Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1030-1(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 73-4(Jul-Aug 1971).

A device is described for filling spark chambers automatically after they have been evacuated in a vacuum box. During the filling process the device ensures a minimal pressure differential of 0.7 torr between the chamber and the box. (auth)

36269 CHERENKOV COUNTER WITH A RADIATOR CONSISTING OF AN AQUEOUS SOLUTION OF AMINO-H-ACID. Kuptsov, A. V.; Nemenov, L. L.; Chirkin, Yu. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1035-8(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 77-9(Jul-Aug 1971).

A threshold Cherenkov counter is described having a radiator consisting of an aqueous solution of amino-H-acid. The efficiency with which the counter records electrons and π-mesons is determined, as well as the dependence of the pulse amplitude on the entry angle and point of incidence of the electrons; a comparison is made between the threshold properties of radiators consisting of water and Plexiglas. (auth)

36270 GRAPHICAL VIDEO INSTRUMENT BASED ON THE BESM-4 AND CDC-1604A COMPUTERS, AND ITS UTILIZATION IN PROCESSING CHAMBER PHOTOGRAPHS. Efimova, A. I.; Zabiyakin, G. I.; Karlov, A. A.; (and others) (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1053-8(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 91-6(Jul-Aug 1971).

Problems in the engineering implementation of a video instrument based on a cathode-ray tube, a light pencil, and the combination of the video instrument with an electronic computer are considered, as well as the utilization procedure and programming softwear of the video instrument for use with the BESM-4 and CDC-1604A computers in order to process photographs from spark and bubble chambers. (auth)

Radiometric Instruments

36271 (AECL-3959) ELECTRON PROBE MICROANALYSER USED FOR DETERMINING THE X-RAY EMISSION DISTRIBUTION IN CARBON AND THE THICKNESS OF CARBON FILMS ON METAL SURFACES. Sawatzky, A.; Jones, S. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Mar 1972. 31p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

The feasibility of using the electron probe microanalyser for non-destructively measuring the thickness of carbon and carbon-iron films which form on heat-transfer surfaces in organic-cooled nuclear reactors was investigated. It was shown that the thickness of carbon films on #431 steel, aluminum and zirconium can be determined over the range 0.1 to 1.5 mg/cm^2 to an accuracy of ±10%. In order to obtain a theoretical expression for x-ray intensity as a function of film thickness which was in good agreement with experiment a new method for determining the x-ray emission distribution was developed. This method was used to obtain the x-ray emission distribution for carbon. (auth)

36272 (CEA-R-4328) TWO-PHASE HYDROGEN MIXTURE DENSITY MEASUREMENTS. Perroud, Paul; Veyrat, Jean-Francois (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr 1972. 61p. (In French). Dep. NTIS (U. S. Sales Only).

The properties of hydrogen slush are recalled, and the laws concerning the attenuation of γ and β radiation by matter are briefly reviewed. Neutron radiation (the use of which is particularly delicate) is also discussed. Two different apparatus gave satisfactory results: a γ densimeter and a β densimeter. These apparatus enable the density of the liquid hydrogen and the slush to be measured and the measurements to be adapted to a liquid-vapor mixture. The calibration is made using liquid hydrogen in a single phase. The γ densimeter is used for the storage tanks. An accuracy of 5/1000 with a response time of 15 seconds is achieved with the γ densimeter. The β densimeter is used for measurements in tubes. The accuracy obtained is 5/1000 with a response time of 4 seconds. The construction of a flow meter using both of these apparatus is feasible. (22 figures, 2 tables) (auth)

36273 (RISO-256, pp 99-111) VOLUME MEASURED BY SUBSURFACE NEUTRON MOISTURE GAUGES. Oelgaard, P. L.; Haahr, V. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.

In Aspects of research at Risoe.

The volume measured by subsurface neutron moisture gages is of considerable importance for the practical application of these gages, both with respect to the determination of the proper calibration drum size and to an evaluation of the resolution of the gage with depth. Results from two series of investigations are reported. The first of these deals with the effect of the drum size on the calibration curve obtained, and is a combined experimental and theoretical investigation. It demonstrates that unless the diameter and the height of the calibration drums are around 80 to 100 cm or larger, important errors may be introduced. The second series is an attempt to estimate the size of the sphere of importance of a gauge in an inhomogeneous, infinite medium, and is based on calculations only. It indicates that the radius of the sphere of importance of a typical Danish soil is 30 to 40 cm at 5 moisture volume per cent and around 20 cm at 30 moisture volume per cent. (auth)

36274 RADIATION GAUGE FOR MONITORING SHEET PROPERTIES EMPLOYING A SCANNED SOURCE. Jernigan, Ernest D. Jr. (to Industrial Nucleonics Corp.). U. S. Patent 3,655,979. 11 Apr 1972. Filed 10 May 1968.

A radiation gage for monitoring a property of a sheet material includes, in combination with an array of stationary detectors positioned across the sheet width, a source of penetrating radiation scanned across the width of the sheet in response to fluid pressure. The source position is determined in response to signals read out from the several detectors comprising the array. The source pattern is effectively maintained isotropic by a slot and key arrangement or by rotating the source at a relatively high spin velocity. The individual detectors are calibrated for different responses across the sheet width. Source detector standardization is performed by translating the source to an off-sheet position so that the source field impinges on an off-sheet detector. In response to standardizing with the off-sheet detector, each of the other detectors is standardized in a like manner. (5 figures) (auth)

36275 FREQUENCY STANDARDIZED PENETRATING RADIATION GAUGE. Doering, George I. (to Industrial Nucleonics Corp.). U. S. Patent 3,655,976. 11 Apr 1972. Filed 11 Oct 1967.

Equipment and method for standardizing the frequency response of a plurality of thickness-measuring radiation gages with resistance-capacitance networks connected to the outputs are described. Each gage is source- and zero-standardized by adjusting a potentiometer in the feedback loop of an amplifier and the zero point of the amplifier, respectively. Thereafter, each gage is frequency-standardized by adjusting the time constant of frequency-determining impedances. The determination of the frequency response of each gage is made by modulating the gage characteristics and measuring the reduction in amplitude of the gage output relative to dc. (4 figures) (auth)

Radiation Effects on Instrument Components, Instruments, and Electronic Systems

36276 EFFECT OF COSMIC RADIATION ON SOLAR CELLS. Grigor'eva, G. M.; Kreynin, L. B.; Landsman, A. P. Geliotekhnika; No. 5, 3-17(1971). (In Russian).

A survey of studies of the mechanism of radiation damage to solar cells, their shielding, and increased resistance to irradiation is presented. The discussion includes the radiation environment in space, the effect of hard radiation on silicon photoconverters—the life of minority carriers in the material, the spectral distribution of the photosensitivity, the photoenergy characteristics, protection of solar cells from cosmic radiation, and the radiation resistance of solar cells. An equation is presented for calculating the damage to silicon photoconverters by protons, high-energy α particles, and, with some approximation, electrons. The equation is subjected to a transformation which makes it applicable when experimental data are available on the effectiveness of damage to photoconverters with protection of a given thickness or preliminary calculations are performed which establish the equivalence between the omnidirectional unit fluxes of particles of various types and energies and the standard radiation flux—in the given case, electrons with an energy of 1 MeV. The most promising methods of improving radiation resistance are considered to be high-temperature annealing of the converters and the manufacture of p-n type photoconverters with an admixture of lithium. Replacement of silicon by GaAs for the manufacture of photoconverters may be useful from the point of view of sensitivity to hard radiation. A lengthy bibliography is presented as a basis for the indicated discussion and conclusions. (TSS) (JPRS)

36277 EFFECTS OF ELECTRON BOMBARDMENT ON THE SHOT NOISE OF SILICON JUNCTION TRANSISTORS. Kerns, D. V. Jr.; Chen, T. M. (Florida State Univ., Tallahassee). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 5, 37-40(Oct 1971).

The effects of 3 MeV electron bombardment on the shot noise properties of silicon junction transistors were studied. The noise figures of the transistors were greatly affected, especially at high source resistances, by the increase of the generation-recombination current in the emitter junction after electron bombardment. The results of noise figure measurements show good agreement with the noise figure equation which contains the generation-recombination factor. A discrepancy between the expression for the emitter noise current derived by Schneider and Strutt and that by van der Ziel is illustrated and the effect of this discrepancy on the expressions for the noise figure is shown. (auth)

36278 EFFECTS OF RADIATION ON SCIENCE INSTRUMENTS DURING GRAND TOUR-TYPE MISSIONS. Parker, Richard H.; Barengoltz, Jack B. (California Inst. of Tech., Pasadena). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 5, 41-9(Oct 1971).

A discussion is presented on the extent of radiation effects encountered with radiation source models and the status of protection techniques for representative science instruments proposed for the Outer Planets Grand Tour missions. Preliminary results of a literature search to collect damage/interference effects data on sensitive components such as silicon detectors and vidicon tubes are described along with results from the various experimenters whose instruments have been used as models in previous studies. (auth)

36279 NEUTRON RADIATION EFFECTS IN JUNCTION FIELD-EFFECT TRANSISTORS. Naik, S. S.; Oldham, W. G. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 5, 9-17(Oct 1971).

A theory is formulated for the static properties of silicon junction field-effect transistors which are compensated with defects with deep energy levels. A single effective level of an acceptor-type 0.40 eV below the conduction band accounts satisfactorily for the degradation of heavily doped n-channel devices with neutron irradiation. Furthermore, based on the existence of defect levels, a frequency dependence of the transconductance is predicted and observed experimentally. The charging and discharging of the defects in the junction space-charge region can follow only at low frequencies. At higher frequencies (above 10–100 kHz at room temperature) the trapped charge cannot respond to the signal frequency very rapidly and the transconductance may be several times higher than the low frequency value. (auth)

36280 NUMERICAL SOLUTION FOR THE RESPONSE OF A STRIP TRANSMISSION LINE OVER A GROUND PLANE EXCITED BY IONIZING RADIATION. Merewether, D. E. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 398-403(Aug 1971).

From 4. symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A numerical solution is presented that may be used to assess the effects of simultaneous excitation of a flat cable by a pulse of ionizing radiation, and by an internal electromagnetic pulse (IEMP) varying with both time and position along the line. The cable is allowed to be closely coupled to a reference conductor and transient changes in dielectric conductivity along the line are allowed. (auth)

36281 COMPARING RADIATION EFFECTS IN GUNN AND IMPATT DIODES. Anderson, Wayne A. (Rutgers–The State Univ., New Brunswick, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 404-9(Aug 1971).

From 4. symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Several Gunn and IMPATT diodes were subjected to neutron and gamma radiation while in oscillation. This provided data which could not be obtained by diode testing after irradiation. Non-passivated IMPATT diodes were most tolerant of neutron fluence effects. Gunn diodes were insignificantly influenced by this radiation flux but failed at lower fluence levels than did the IMPATT diodes. (auth)

Miscellaneous Instruments and Components

Refer also to abstracts 36000, 36026, 36149, 36472, 36559, 37589, and 37741, 37980, and 37995.

36282 (CEA-CONF-1980) SOME WORK IN THE FIELD OF TIME MEASUREMENTS. Van Zurk, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1971. 31p. (CONF-710956-1). Dep. NTIS (U. S. Sales Only).

From sixth international symposium on nuclear electronics; Warsaw, Poland (Sep 1971).

The following devices are successively described: a sliding pulse generator intented to check rapidly the differential linearity of time analyzers; a special-purpose generator to study experimental time resolution in the picosecond range; a short-rise time (~2 ns) triggerable light pulse generator (λ = 650 nm) having very small jitter (25 ps fwhm); a time-to-pulse height converter, including an adjustable device which compensates the timing error due to leading-edge variation of p–i–n detector Stop pulses; and a time-to-pulse height converter based on the Start–Stop principle (its range and electronic resolution time are, respectively, 50 ns and 2.2 ps (fwhm)). (18 figures, 2 tables) (R.W.R.)

36283 (DESY--72/14) KERR CAMERA WITH TEN PICOSECONDS TIME RESOLUTION. Fischer, R.; Rossmanith, R. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1972. 8p. Dep. NTIS (U. S. Sales Only).

A camera with a CS_2-filled Kerr cell shutter is described. The shutter is opened by the pulse of a mode locked Nd-glass laser. Due to the short relaxation time of the CS_2, a time resolution of 10 ± 2 ps is attained. The camera with laser-driven Kerr cell is designed for measuring light pulses emitted from relativistic electrons in high-energy accelerators. (4 figures) (auth)

36284 (LNF-71/81) OPTICS OF THE MAGNETIC SPECTROMETER IN APPROXIMATIONS OF THE FIRST AND SECOND ORDERS. PART I. THE DIFFERENTIAL EQUATION OF THE TRAJECTORY IN PRECISE FORM. Sanna, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 29 Nov 1971. 16p. (In Italian). Dep. NTIS (U. S. Sales Only).

An analysis as detailed as possible of the optical behavior of the magnetic spectrometer is presented. The differential equations of the trajectory in precise form are derived. (J.S.R.)

36285 (SFB-MHD-2) LEVEL MEASUREMENTS ON ALKALI METALS AT TEMPERATURES UP TO 900^{0}C BY MEANS OF RESISTANCE ELEMENTS. Wagner, K. (Technische Universitaet, Berlin (West Germany)). Mar 1971. 85p. (In German). Dep. NTIS (U. S. Sales Only).

Resistance type level indicators have been developed and tested for alkali metals at high temperatures. Because of the strength of materials at high temperature the ultimate length of such tubes is limited to 1.5 m. Up to 850°C the temperature compensation amounts to 0.5%. Tests were carried out in potassium (400 ppM oxygen) at 820°C with no failure. Now Haynes–25 level indicators are in fabrication, usable up to 950°C. At all temperatures the error was ±20 mm regardless of cover gas (argon or potassium vapor) and oxygen content, if the calibration was calculated. By experimental calibration the error can be reduced to ±10 mm. The electronical equipment for electrical supply and measurement are presented. (auth)

36286 (WERL-TAGOV-2) CALIBRATION OF GAMMA MONITORS. Roidt, R. M.; Stewart, W. A. (Westinghouse Research Labs., Pittsburgh, Pa.). 11 May 1972. Contract AT-11-1-GEN-14. 28p. Dep. NTIS.

A molten tin bath has been utilized to calibrate four gamma monitors in the temperature range, 500°F to 700°F, for internal heating rates of from 2 watts/in to 15 watts/in. The experimental scatter on a $(q/L)/\Delta T$ versus $\overline{T}$ plot is less than ± 5 percent for heater element powers greater than 5 watts/in but lower power inputs do not correlate successfully on this plot. A description of the molten tin bath and experimental technique is given. (auth)

36287 NANOSECOND PULSE HEIGHT ANALYZER. Friedman, Jerome D. (to Secretary of the Air Force). U. S. Patent 3,659,101. 25 Apr 1972. Filed 10 Sep 1970.

A nanosecond pulse height analyzer utilizing a cathode-ray tube (CRT) in conjunction with an array of photo-sensitive elements is described; the CRT beam is deflected to a height proportional to the energy of, for example, a γ-ray photon which was detected to provide the deflecting signal. At the peak height the grid of the cathode ray tube is gated. A photo-sensitive device at this position registers this event into the associative memory, each photo-sensor corresponding to a different energy. At the end of a counting period each memory can be read at leisure. (1 figure) (auth)

36288 SEPARATION OF MICROGRAM QUANTITIES OF LOW ISOTOPIC ABUNDANCE UTILIZING AN ISOTOPE SEPARATOR. Leonard, R.; Ponting, R. L.; Sheline, R. K. (Florida State Univ., Tallahassee). Nucl. Instrum. Methods; 100: No. 3, 459-60 (1972).

A ^{210m}Bi target, with a thickness lower limit of 4 μg/cm^2, was prepared from 1.39 mg of bismuth with an isotopic abundance of 2.5% ^{210m}Bi. The 35 μg of ^{210m}Bi was successfully separated because of modifications in the ion source. It is suggested that these techniques may be important in the preparation of targets of the transuranic elements, for reaction spectroscopy studies, and in the search for new elements with Z of 110 to 114 and ≈126. (1 figure, 1 table) (auth)

36289 PULSE-SHAPING IN LOW-NOISE NUCLEAR AMPLIFIERS: A PHYSICAL APPROACH TO NOISE ANALYSIS. Goulding, F. S. (Univ. of California, Berkeley). Contract W-7405-eng-48. Nucl. Instrum. Methods; 100: No. 3, 493-504(1972).

Analysis of the relative noise performance of many types of pulse-shaping systems is discussed in terms of recent work on noise analysis. The simplicity of the method and its direct connection to physical processes are stressed. Applications of the technique to time-variant as well as time-invariant systems are illustrated. (10 figures) (auth)

36290 MINIATURE GONIOMETER FOR MOUNTING IN REACTOR BEAM HOLE. Fink, D.; Fischmann, U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Instrum. Methods; 100: No. 3, 549-50(1972). (In German).

A miniaturized goniometer was developed for an in-pile reactor experiment. The maximum dimensions are 75 × 24 × 24 mm^3; the mounted specimen can be turned by steps of 0.02° with a precision better than ±0.01°. (1 figure) (auth)

36291 NOISE IN FET'S AT LONG TIME CONSTANTS, SUPPORT FOR A THEORY DUE TO VAN DE ZIEL. Young, D. C.; Hardie, D. (Nuclear Enterprises Ltd., Edinburgh). Nucl. Instrum. Methods; 100: No. 3, 553-4(1972).

Experimental results are given which indicate trapping as a major source of noise at long time constants. (2 figures) (auth)

36292 INSTRUMENT DESIGN CONSIDERATIONS AND CLINICAL APPLICATIONS OF STABLE ISOTOPE ANALYSIS. Klein, Peter D.; Haumann, Joseph R.; Eisler, William J. (Argonne National Lab., Ill.). Clin. Chem.; 17: No. 8, 735-9(Aug 1971).

From third annual symposium on high-resolution analyses and advanced concepts for the clinical laboratory; Oak Ridge, Tenn. (11 Mar 1971).

Stable isotope analysis by gas chromatography—mass spectroscopy—accelerating voltage alternation (GMA) is a new concept which makes it possible to eliminate radiological hazard from clinical tracer studies. To become useful to, and used by, the clinician, this instrumentation must eventually become competitive with that for liquid scintillation counting from the standpoint of sample size, sensitivity, automation, routine operation, and cost. A second-generation instrument, recently constructed in the Division of Biological and Medical Research at Argonne National Laboratory, was put into operation and is being used in collaborative clinical studies conducted at the Mayo Clinic. The design features and operating characteristics of this system are discussed with reference to the ultimate clinical requirements. (3 figures, 3 tables) (auth)

36293 SQUARE ROOT FUNCTION GENERATOR USING A BINARY RATE DIVIDER. Rao, D. N.; Glen, J. L.; Taylor, D. (Univ. of Strathclyde, Scotland). Nucl. Instrum. Methods; 100: No. 3, 381-5(1972).

By using a relatively new component, the binary rate divider, a simple circuit may be devised for generating a square root function, e.g. $\sqrt{(N)}$, where N is the number of counts per unit time. This is of particular interest where an automatic display of the standard deviation of a long series is desirable in counting random events, and when random events are to be encoded for transmission by line or radio, to allow bandwidth economy in the transmission system. (6 figures, 1 table) (auth)

36294 MAGNETOMETER FOR LOW FIELDS WITH 10 ppm RESOLUTION. Claessens, Ch.; Warnant, H.; Boving, R.; Jones, A. (Univ. Louvain, Belg.). Nucl. Instrum. Methods; 101: No. 2, 279-86(1972). (In French).

This magnetometer has a 10 ppM resolution in measuring fields between 30 and 200 G, performances being independent of room and probe temperature. Measures are achieved by means of nuclear resonance of premagnetized flowing water. The probe contains only 1 cm^3 of water. (auth)

36295 PULSE DELAY GENERATOR. Bialkowski, J.; Karnicki, W. (Inst. of Nuclear Research, Warsaw). Nucl. Instrum. Methods; 101: No. 2, 353-8(1972).

The principle of operation of the Pulse Delay Generator (PDG) and the circuitry and results of measurements of the parameters are described. Special attention is concentrated on the effect of the counting rate increase on the PDG performance, and it was found that the PDG may be combined with the Time to Pulse Height Converter (TPHC) in life-time measurements. The instrument can be used in delay ranges from 50 ns to 8 ms. It is found especially useful for the delay times above 1 μs. (auth)

36296 DISTORTIONS IN THE ANALYSIS OF MULTIPOLE COMPONENTS IN QUADRUOPLE END FIELDS CAUSED BY LONGITUDINAL FIELD COMPONENTS AND SAG ON THE PROBE ARM. Jung, V. (Kernforschungszentrum Karlsruhe, Ger.). Nucl. Instrum. Methods; 101: No. 2, 225-30(1972).

At incremental measurements in the end regions of a quadrupole field on circles concentric to the field axis, by means of a Hall probe, distortions of the measured fluctuation of the field value are caused by the sag of the probe carrier and by longitudinal field components. The theoretical error curve is calculated. It turns out to be of no influence on the Fourier analysis of the multipole components upward of the octopole. However, for analysis of the hexapole components, only measured values on the axes of the pole gaps may be used at points where the longitudinal end field disappears. Sag of the probe simulates a weak octopole component, the end field a weak dodecapole component. (auth)

36297 CHARACTERISTICS OF PYROLYTIC GRAPHITE AS AN ANALYZER AND HIGHER ORDER FILTER IN NEUTRON SCATTERING EXPERIMENTS. Shapiro, S. M. (Brookhaven National Lab., Upton, N. Y.); Chesser, N. J. Contract AT(30-1)-4048. Nucl. Instrum. Methods; 101: No. 2, 183-6(1972).

Pyrolytic graphite (PG) has become nearly indispensable in neutron spectroscopy. Its use as a monochromator and/or analyzer crystal in a triple-axis spectrometer has previously been discussed. Since the reflectivity varies as a function of energy, observed neutron intensities must be corrected for the analyzer reflectivity. Presented are detailed measurements of the reflectivity of the (002) reflection for incident neutron energies from 4.5 to 40.0 MeV. There are relatively large dips at 15.3 and 23.6 MeV which result from competing Bragg reflections. It is also pointed out that the width of the rocking curve increases as the energy is decreased. This must be considered when making resolution function corrections. PG in bulk form has been extremely useful as a higher order filter in the 13.0 to 15.0 MeV range. It is shown below that it can also be used effectively in the very low energy range, 4.5 to 6.0 MeV. (auth)

36298 CIRCULAR CALCULATOR FOR THE SOLUTION OF PROBLEMS CONNECTED WITH ELECTROMAGNETIC RADIATION PENETRATION. Gaggero, Giancarlo; Tamagnini, Carla Mongini; Settipani, Antoine (to EURATOM). British Patent 1,272,760. 3 May 1972. Filed 8 Nov 1968.

A calculator is described for the rapid performance of calculations associated with, for example, gammagraphy, radiography, radioprotection, etc. It enables determination of any one of the following parameters as a function of the remainder—source intensity, exposure time, shield thickness, source-target distance, radiation dose at target position and a quantity related to the radiation effect on the target. It comprises three concentric disks of different radii movable relative to one another around an axis; scales with pointers are provided on the disks for the above parameters. A FORTRAN program is given for automatic design of the calculator. Provision is made for evaluation of the appropriate theoretical formulae. (UK)

36299 MEASUREMENT OF THICKNESS OF FUEL-ELEMENT CANS BY ELECTROMAGNETIC METHODS. Andreescu, N.; Baltac, I.; Andreescu, O. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 16: No. 9, 915-34(1971). (In French).

A simplified model is proposed which can approximate sufficiently well the mutual action between the measurement coil and the conductor tube in the case of the Foucault current method. This model expresses certain peculiarities of the impedance hodograph and shows that $\Delta L'/L$ and $\Delta R'/\omega L_0$ (the relative variations due to the different defects) remains almost constant for certain variations of the coil parameters. This observation is very important for the optimization of the measurement circuits. The results obtained with the aid of two variants of the Foucault current method are then described: the variant with two encircling measurement coils whose sensitivities are, for the variations due to the external diameter, 0.33% (for the controlled Al tubes) and the variant with single encircling coil whose sensitivity is 0.16%. The sensitivity of the wo variants, for the variations of the thickness due to the internal diameter, is about 5 times smaller for the chosen measurement frequency. (tr-auth)

36300 MEASURED TIME AND FREQUENCY RESPONSE OF A MINIATURE SUPERCONDUCTING COAXIAL LINE. Ekstrom, M. P. (Univ. of California, Livermore. Univ. of California, Davis); McCaa, W. D. Jr.; Nahman, N. S. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 5, 18-25(Oct 1971).

A miniature superconducting 52 ohm coaxial transmission line 278 meters long, having a lead outer conductor (0.129 cm id), a Teflon dielectric, and a niobium center conductor (0.038 cm), has been measured in both the time and frequency domains. The observed system step response (10 to 90%) times were 1.5 μs at room temperature, 375 ns at 77°K, and 255 ps at 4.2 K. The system step response data for 4.2 K was processed by a numerical system identification routine to determine the step response of the miniature superconducting line; the processed data gave a 220 ps rise time. Although the observed step responses at 4.2 K were smooth transitions, the observed swept frequency (0.1 to 12 GHz) attenuation at 4.2 K was a quasi-periodic function of frequency, which indicated that the nonuniformity of the superconducting line was significant. For example, near 5 GHz and at 4.2 K, the attenuation minimum was 1.1 dB while about 0.5 MHz away the attenuation was 5 dB. By making normal conductivity measurements of the Nb conductor and incorporating the results into the two fluid model, the uniform line attenuation for 5 and 10 GHz was calculated with the classical and anomalous limits. The lowest observed attenuation values in the vicinity of 5 and 10 GHz fell between the computed classical and anomalous limit attenuation values. (auth)

36301 NANOSECOND PHOTOGRAPHY OF SHOCK-INDUCED ELASTIC RIPPLES. Holland, Richard; Weaver, Douglas L. (Sandia Labs., Albuquerque, N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 5, 26-36(Oct 1971).

When electronic circuitry is exposed to a shock wave of nuclear origin, intense acoustic agitation occurs within each of the components. Obviously, each component must be exceedingly strong mechanically in order to withstand such conditions. The survival of transistors and integrated circuits was studied. In these devices there is a tendency for elastic or plastic surface ripples to develop on the headers or flatpacks. These ripples previously were quite difficult to record, although they were known to be the primary cause for cracking of transistor chips or microcapacitors from their substrates. However, a system for photographing such motions on polished surfaces is now used. This system is based on incoherent (or geometrical) optics, and thus does not require the use of a massive optically stable bench. Up to 130 frames may be taken in 6.5 μsec at a rate of 50 nsec/frame. It is possible to observe disturbances as small as 100 μm wide by 0.1 μm high, and group velocity may be as fast as 5×10^9 μm/sec. For illustration, photographs of ripples on a transistor header which has been subjected to a shock wave generated by a pulsed electron beam are presented. (auth)

36302 CRYOGENIC-SENSING DEVICE USING URANIUM MONOPHOSPHIDE–URANIUM MONOSULPHIDE. Kuznietz, Moshe; Lander, Gerard H.; Baskin, Yehuda (to United States Atomic Energy Commission). U. S. Patent 3,646,813. 7 Mar 1972. Filed 9 Sep 1969.

The sensor of the present invention includes a solid solution of uranium monophosphide and uranium monosulfide having a composition of $UP_{1-x}S_x$ where x = 0.2 to 0.3. The uranium monophosphide-uranium monosulphide solid solution is coupled to a temperature environment and a dc magnetic field, either of which may be varied and sensed. A sense coil is mounted adjacent the uranium monophosphide-uranium monosulphide solid solution to sense the magnetization of the uranium monophosphide-uranium monosulphide solid solution relative to the values of the temperature environment and magnetic field. (auth)

36303 NEUTRAL-ATOM-STREAM ANALYZER. Konstantinov, S. G.; Sorokin, A. F.; Tsel'nik, F. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1006-7(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 54-5(Jul-Aug 1971).

The layout of a neutral-atom spectrum analyzer with conversion of the neutral atoms into ions in a pulsed gas target is described. (auth)

36304 MEASUREMENT OF THE CHARACTERISTIC OF COINCIDENCE AND ANTICOINCIDENCE CIRCUITS BY MEANS OF A TIME-AMPLITUDE CONVERTER. Kryshkin, V. I.; Stibunov, V. N.; Fedorov, N. P. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1062-3(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 99-100(Jul-Aug 1971).

A procedure is described for the precise measurement of the curves of delayed coincidences and anticoincidences for minimum time expenditures. (auth)

36305 OPTIMAL ADJUSTMENTS OF ION SOURCES OF GAS MASS SPECTROMETERS. Tschedjemov, G.; Todt, W.; Lippolt, H H. J. (Laboratorium fuer Geochronologie, Heidelberg). J. Mass. Spectrom. Ion Phys.; 9: No. 1, 1-14(Jun 1972). (In German).

Mass spectrometers are used in isotope geology for sensitive and very precise isotope ratio measurements. For greater accuracy of measurement, the ion source of such a mass spectrometer should not be set for greatest sensitivity, but rather to achieve long-period stability of ion production and of isotope-ratio measurements. The optimal adjustment of two commercial ion sources is presented; and their respective short- and long-term stability reported. In the case of the MI-1305 mass spectrometer it can be shown that, under optimum working conditions, the relative ion production is independent of the amount of argon present (i.e. between 2×10^{-8} cm^3 and 10^{-4} cm^3 STP). The routine reproducibility of the measured atmospheric ^{40}Ar/^{36}Ar ratio with this instrument is shown to be ± 2.5%. In the case of the GD-150 mass spectrometer, routine atmospheric ^{40}Ar/^{36}Ar ratio measurements vary by ± 0.5% over a period of a month and by ± 1.2% over a period of a year (when measurements are made using gas volumes ranging from 4×10^{-7} cm^3 STP to 2×10^{-5} cm^3 STP). (12 figures, 2 tables) (auth)

36306 DEVELOPMENT OF A TIME-OF-FLIGHT MASS SPECTROMETER TO MONITOR FAST GAS REACTIONS. Howarth, S. B.; Lippiatt, J. H.; Price, D.; Ward, G. B.; Myers, P. (Univ. of Salford, Eng.). J. Mass Spectrom. Ion Phys.; 9: No. 1, 95-105(Jun 1972).

Modifications to a Bendix 14-107 time-of-flight mass spectrometer resulted in a ten-fold reduction in the relative statistical fluctuation in the measured cycle-to-cycle peak heights of the mass spectra. Preliminary results, obtained by application of the modified instrument to monitor the flash photodecomposition of lead tetramethyl and the shock wave pyrolysis of 1,2-dichloroethylene, are given. (6 figures, 1 table) (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

36307 (ORNL-IIC-33) BIBLIOGRAPHY OF DIVISION OF ISOTOPES DEVELOPMENT AND CONTRACTOR PUBLICATIONS. Baker, P. S. (comp.) (Oak Ridge National Lab., Tenn.). May 1972. Contract W-7405-eng-26. 220p. Dep. NTIS.

A list of publications is presented which covers activities through 1971 under the isotopes development program. Reports bearing directly on this program, which have been issued by the Division of Isotopes Development, its research and development contractors, AEC national laboratories, and other Government agencies cooperating in isotope development, are included; however, short-term progress reports have been deleted. Many research efforts are continuing, while new projects in promising areas of radioisotope development are initiated from time to time. (auth)

Isotope Separation (Industrial)

Refer also to abstracts 35884, 35885, and 35887.

36308 (K-1490) EVALUATION OF THE PERFORMANCE OF THERMAL DIFFUSION COLUMNS SEPARATING XENON ISOTOPES. Blumkin, S.; Von Halle, E. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 16 Jan 1962. Contract W-7405-eng-26. 35p. Dep. NTIS.

Declassified 1 Nov 1971.

A correlation and analysis has been made of equilibrium and transient data obtained from hot-wire thermal diffusion columns separating xenon isotopes. The observed performance of the columns is compared with that predicted by theory. (auth)

Isotopic Power Sources

36309 (GE-TM-65-11-21) SOME SAFETY CONSIDERATIONS FOR ^{238}Pu FUELED LARGE ISOTOPIC HEAT GENERATORS. Bermanis, H. L. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 22 Nov 1965. 12p. Dep. NTIS.

Declassified 27 Oct 1971.

The criticality safety of large, space vehicle-used heat sources consisting of 24 capsules of ^{238}Pu was calculated for conditions of soil impaction following reentry from space. The calculations were performed to determine whether a ^{238}Pu fuel charge could go critical and what would be the consequences of such accidental criticality. It was concluded that: criticality would occur upon impact; a reaction comparable to a chemical explosion would result; the fuel would be widely dispersed into the atmosphere; and it is necessary to provide some means to avoid criticality on impact or as a result of insulating burial. (L.C.L.)

36310 (HIT-260) DESIGN AND FABRICATION OF SPHERICAL FUEL CAPSULES FOR RADIOISOTOPE GENERATORS. Final Report. (Hittman Associates, Inc., Baltimore, Md.). 30 Jun 1967. Contract AT(29-2)-2072. 184p. Dep. NTIS.

Declassified 2 Nov 1971.

Activities in programs devoted to the design, development, fabrication, and test of spherical radioisotope capsules are described. Results of a spherical design study are reported along with those obtained in parametric aerodynamic studies. Work directed to capsule development, fabrication and assembly is summarized. Capsule performance test results are included along with an evaluation of these tests. (J.R.D.)

36311 (ORNL-TM-3687) ISOTOPE KILOWATT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 30, 1971. Fraas, A. P.; Samuels, G. (Oak Ridge National Lab., Tenn.). Apr 1972. Contract W-7405-eng-26. 32p. Dep. NTIS

Activities in programs to develop 2-, 3-, and 5 kW(e) radioisotope energy conversion systems are reported. In October four capsules were removed from the capsule decomposition test block after 7085 h of operation at 600°F. Test results indicate that a 5-yr unattended life should be attainable for a proposed full-scale organic Rankine cycle system. The organic capsule decomposition test continued throughout the balance of the quarter without incident. The total operating time on the original capsules at the end of December was 8477 h and the time on the new capsules was 1392 h. Fabrication of components for the quarter-scale organic fluid decomposition test loop was completed and assembly of the components for the loop was about 60% completed by the end of December. The thermoelectric module continued to operate throughout the quarter to give 3156 h at the end of December. Some evidences of degradation in the electrical output have begun to appear. The design analysis and the design of the heat pipes for the full-scale heat block-shield test have been completed. Results of design analysis of these new heat pipes with a simpler construction indicate that, ideally, they should give sufficient output for all inclinations from normal vertical to an inclination of -19° (i.e., with the condenser below the evaporator region). The components for the first heat pipe for the shield block test have been fabricated, and preliminary test results are favorable. Recent experience at Los Alamos with stainless steel-sodium heat pipes indicates that both cold trapping and hot trapping are required to make the performance of the heat pipe approach calculated values. The thermal conductivity tests on the first combined aluminum screen-foil insulation were completed. Insertion of the foil in the screen matrix gave a marked improvement in the thermal radiation losses and thus the overall insulating value. The meltdown test of the combined aluminum screen-foil insulation specimen was then conducted. Results of a preliminary analysis of the data and inspection of the screen following the meltdown indicate that the insulation will protect the fuel elements in the event that normal heat removal from the block is lost. This type of insulation was then chosen for the $^{1}/_{4}$-scale thermal insulation test rig, and the system built. The system was placed in operation December 26 and thermal conductivity tests with a system nitrogen pressure of 15 psia were initiated. The heat block-shield unit was received and set up for testing. A simulated fuel loading test was run by bringing the simulated fuel elements to temperature and then inserting them into the holes in the heat block-shield. No difficulties were encountered during the insertion of the seven elements. The shipping and long-term storage tests were completed for both $SrTiO_3$ and SrF_2 fuel with maximum temperatures in the simulated fuel capsules of 1042 and 979°F respectively. In a test simulating an accident in which the unit fell from a truck it was found that, with the unit laying on its side and 110° of the surface covered with sand, the maximum fuel element temperature was 1161°F. Detail design work on the full-scale organic system continued. About 60% of this work was completed at the end of December. A comprehensive analysis of the control system has been initiated. (auth)

36312 NUCLEAR RADIATION SOURCES ON BOARD OUTER-PLANET SPACECRAFT. Noon, Edward L.; Anno, George H.; Dore, Michael A. (California Inst. of Tech., Pasadena). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 5, 50-7(Oct 1971).

The nuclear characteristics of plutonium fuel which give rise to the radiation from both RTG's and RHU's and Monte Carlo estimates of the neutron and gamma isodose profiles from a 2200 watt (th) HELIPAK thermoelectric generator are summarized. Also, a presentation summary of shield thicknesses required for several sensitive radiation experiments due to combined RTG-RHU fields is given. This study is a part of a continuing program of analysis at the Jet Propulsion Laboratory on the evaluation of RTG radiation fields on an outerplanet spacecraft. (auth)

Radiation Sources

Refer also to abstracts 35978 and 36044.

36313 ^{252}Cf PROGRESS. Californium-252 Progr.; No. 11, 1-52(Apr 1972).

ACTIVATION ANALYSIS—neutron source for, properties of californium-252
CALIFORNIUM-252—sales by USAEC through Jan. 15, 1972
MINERALS—exploration of, evaluation of californium-252 neutron sources for use in
NEOPLASMS—radiotherapy of, evaluation of californium-252 as neutron source for
NEUTRON SOURCES—supply and uses of californium-252
  —evaluation of californium-252, for use in radiotherapy
  —evaluation of californium-252, for use in radiography
  —evaluation of californium-252, for natural exploration
  —evaluation of californium-252, for use in process control and quality control
  —fabrication of californium-252, in bare cermet wire form
  —properties of californium-252, for use in activation analysis

QUALITY CONTROL—neutron source for, evaluation of californium-252
RADIOGRAPHY, INDUSTRIAL—neutron source for, evaluation of californium-252
RADIOTHERAPY—neutron source for, evaluation of californium-252 (R.C.K.)

36314 RADIOISOTOPES. RADIOACTIVE PHARMACEUTICALS, RADIOACTIVE CHEMICALS, RADIOACTIVE SOURCES, SERVICES. Kjeller, Norway; Institutt for Atomenergi (1972). 40p.

Brochure.

Specifications, prices and delivery times for eighty-eight radioactive pharmaceuticals and chemicals produced by Institutt for Atomenergi are given. Cobalt-60, iridium-192, and gold-198 sources for laboratory and industrial use and a variety of beta and gamma sources for training and demonstration purposes are described and prices given. Irradiation services are also available and containers flux, etc. are specified. Standardized sources and solutions and absolutely standardized/solutions are also available. The Institute for Atomic Energy also offers services in activation analysis, and in the industrial applications of radioisotopes. (auth)

36315 NEW ASPECTS AND METHODS OF INDUSTRIAL USE OF ISOTOPES IN HUNGARY. Foeldiak, G. (Institut fuer Isotope, Budapest). Isotopenpraxis; 7: No. 8, 315-20(Aug 1971). (In German).

The problems of isotope use in Hungarian industry and the development of new methods are considered from three viewpoints. The first is the modernization of the industrial production methods and the new types of requirements with respect to isotope technology. The economic aspects of the nuclear methods and the usefulness of isotope techniques are then considered. The development of organizations equipped to issue rules and regulations on the use of isotopes and to provide incentives of their use is also of importance in the increased use of isotopes in Hungary. (J.S.R.)

36316 USE OF LOW-ENERGY GAMMA EMITTERS FOR RADIOGRAPHIC INVESTIGATION. Fenyvesi, E. (Csepel-Werke, Budapest). Isotopenpraxis; 7: No. 8, 351-3(Aug 1971). (In German).

The use of ^{75}Se and ^{170}Tm for the radiographic nondestructive testing of thin-walled steel and light metal products in those cases where x-radiation testing is unsuitable was investigated. The half-value thickness of steel, lead and aluminum was determined. The picture quality obtainable with the two isotopes was tabulated for various wall thicknesses. A ^{192}Ir source was compared with the ^{75}Se and ^{170}Tm sources. The three isotopes can be used for testing walls of less than 10 mm thickness. (J.S.R.)

Design and Fabrication

36317 (HW-83609(Suppl.)) PROGRESS IN FISSION PRODUCT RECOVERY AT HANFORD. SUPPLEMENT. A SUMMARY OF HANFORD LABORATORIES ACHIEVEMENTS IN THIS PROGRAM UNDER GENERAL ELECTRIC, 1954-1964. Moore, R. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Nov 1964. Contract AT(45-1)-1350. 8p. Dep. NTIS.

Declassified 2 Nov 1971.

Industrial Uses

36318 (CONF-6709102) OPERATION IRAD FOR FURTHERING THE APPLICATION OF IRRADIATION TECHNIQUES. Busse, F. (ed.) (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). [nd]. 89p. (In German).

During the fall of 1967 and spring of 1968 a project, called AKTION IRAD, was undertaken to present, at various European locations, information about irradiation techniques and to give demonstrations using a mobile gamma irradiation unit, IRMA, which contained a 180,000 Ci ^{137}Cs source. In addition to the irradiation demonstrations, the presentations included exhibits on the uses of irradiation techniques in agriculture and medicine and in the chemical, construction, and food industries, distribution of information material, lectures, movies, and panel discussions. The presentations elicited strong interest by the general public as well as by industrial representatives. More than 350,000 visitors attended, 15,000 samples were irradiated, and 120,000 pamphlets were distributed. The lectures given along with the demonstrations, movies, and exhibits used during the presentation at Bremerhaven from Sept. 24 through 27, 1967 are presented as a compilation. (H.B.G.)

36319 (CONF-680477) TECHNIQUES OF INDUSTRIAL IRRADIATION. IRAD Proceedings at Milano. Petrozzi, E. E. (ed.) (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). 1970. 122p. (In Italian).

This collection of 16 lectures represents a course in the techniques of radiosterilization and radiopreservation of foodstuffs, intended for individuals who had no prior experience with radiation and radioisotopes. Basic information on the latter two subjects is covered, and followed by brief reviews of the effects of radiation on microflora, and the practice of preservation of foods of animal and vegetable origin, fish products, and general economic considerations. (K.S.W.)

36320 (TID-25998) BIBLIOGRAPHY ON THE CENTRALIZED PROCESSING OF FRESH MEAT AND POULTRY INCLUDING RADIATION PASTEURIZATION (UPDATED). Urbain, W. M.; Belo, P. S.; Giddings, G. G.; Wang, S. (Michigan State Univ., East Lansing. Dept. of Food Science and Human Nutrition). Mar 1972. Contract AT(11-1)-1689. 74p. Dep. NTIS.

References (611) plus 14 related patents are given to journals, abstract journals, and reports on radiation processing of fresh meat and poultry under the general breakdown of radiation pasteurization of fresh meat and poultry and related radiation references, retailing and wholesaling of fresh meat and poultry including centralized cutting, pigment and color of fresh meat and poultry, fluid exudation and water holding capacity of fresh meat and poultry, and general microbiology of fresh meat and poultry. Separate author and subject indexes are included. (P.C.H.)

36321 IDENTIFICATION OF IRRADIATED MUSHROOMS. Bugyaki, L. (Institut d'Hygiene et d'Epidemiologie, Brussels); Heinemann, P. Atomkernenergie; 19: No. 3, 261(May 1972). (In French).

Effects of radiation processing on mushrooms are briefly discussed and legal aspects of the sale of irradiated mushrooms are considered. In order to determine whether mushrooms were irradiated or not it was necessary to develop a method for distinguishing between irradiated and non-irradiated mushrooms. Samples of Agaricus hortensis were obtained from a local producer and divided into three groups. One group was gamma-irradiated using a ^{60}Co source and kept at room temperature. Two unirradiated groups were kept at room temgroups and placed in Petri dishes containing corn meal agar and other agar media. After eight hrs of incubation, growth of hyphae was observed on the unirradiated cuttings and after 24 hrs there was pronounced development of hyphae. However, there was no growth of hyphae on the irradiated mushrooms. This procedure proved to be a reliable method of identifying irradiated mushrooms. (H.L.W.)

LIFE SCIENCES

Radiation Effects on Biochemicals (External Source)

Refer also to abstracts 35910, 35915–35917, 35927, 35937, 36344, and 36400.

36322 (AEC-tr–7304, pp 149-53) MOLECULAR MECHANISMS OF THE CHEMICAL PROTECTION OF NUCLEIC ACIDS FROM THE ACTION OF RADIATION. Eydus, L. Kh. (Inst. of Biological Physics, Pushchino, USSR). Translated from Radiobiologiya; 11: No. 4, 595-8(1971).

The physicochemical mechanisms of the protection and repair of macromolecular structures are discussed. On the basis of an analysis of the literature data, it was shown that the mechanisms reducing radiation damage to the protein molecules are also effective with respect to nucleic acids and nucleoproteins. A physical explanation for the mechanism, which may lie at the basis of the so-called biochemical shock, arising in living objects under the action of chemical protectors, is suggested. (tr-auth)

36323 (AEC-tr–7304, pp 159-61) INVESTIGATION OF THE EFFECTS OF GAMMA RAYS ON SOLUTIONS OF PLANT DEOXYRIBONUCLEOPROTEIN BY THE METHOD OF LOW GRADIENT VISCOSIMETRY. Popkov, V. P.; Rik, G. R. (Agrophysical Scientific Research Inst., Leningrad). Translated from Radiobiologiya; 11: No. 4, 602-3(1971).

The effects of the gamma rays of ^{60}Co on a solution of plant DNP were studied by the method of low-gradient viscosimetry. In the region of doses up to 200 rad, a decrease in the intrinsic viscosity of the DNP solutions was observed. (tr-auth)

36324 PROTECTION OF CATALASE FROM RADIATION-INACTIVATION BY ADENOSINE AND ITS DERIVATIVES IN DILUTE SOLUTION. Takagi, Yoshinari (National Inst. of Radiological Sciences, Chiba, Japan); Okazaki, Masahiko; Shikita, Mikio. J. Radiat. Res.; 12: No. 3-4, 100-4(Sep-Dec 1971).

Aqueous solutions of catalase were irradiated with ^{60}Co gamma rays. The protective action of adenosine and its derivatives was examined under the conditions where the yield of the enzyme inactivation was independent upon the initial concentration of the enzyme. By increasing the concentration of the protective substance, a maximal protection was observed. The level of the maximum was dependent on the chemical structure of the protective substances. Addition of excess amounts of adenosine decreased the effectiveness of its N_6-hydroxyethyl derivative which was more protective, by itself, than adenosine. Based upon these observations, it was assumed that the binding of the protective substance to the enzyme molecule was the basis of the protection of the enzyme. (auth)

36325 EFFECTS OF ^{60}Co GAMMA RAYS ON LYSOZYME IN AQUEOUS SOLUTION. II. Yamamoto, Kazuhiko (Osaka Univ.). J. Radiat. Res.; 12: No. 3-4, 133-7(Sep-Dec 1971).

Egg-white lysozyme was irradiated in 0.5% aqueous solution with cobalt-60 γ rays. The resulting samples were fractionated by gel-filtration of Sephadex G-100 and treated with mercaptoethanol in order to clarify the polymerization caused in radiation-inactivated lysozyme. The gel-filtration pattern of irradiated lysozyme revealed two protein fractions. The first peak showed no enzyme activity and higher molecular weight than intact lysozyme. The second corresponded to intact lysozyme. Mercaptoethanol-reduction studies showed the conversion of inactive polymerized component of irradiated lysozyme into a form derived from intact lysozyme by this treatment. These results suggest that a large part of inactivation of lysozyme by γ irradiation proceeds by way of polymerization caused by intermolecular disulfide bond and the polymerized component is responsible for radiation-inactivation of lysozyme. (auth)

36326 IMPOSSIBLE FORMATION OF TWISTED CIRCULAR FORM DNA AFTER INFECTION WITH ULTRAVIOLET IRRADIATED lambda PHAGES. Tokunaga, Fumio; Nozu, Keiichi (Osaka Univ.). J. Radiat. Res.; 12: No. 3-4, 148-52(Sep-Dec 1971).

Studies on twisted circular form DNA showed that there was no conversion of λ DNA into the twisted circular form DNA molecules when E. coli cells were infected with ultraviolet-irradiated λ phages. (auth)

36327 REPAIR OF RADIATION-INDUCED DNA STRAND SCISSIONS IN CHLORELLA DURING THE CELL CYCLE. Cabela, E.; Wawra, E.; Altmann, H. (Reaktorzentrum, Seibersdorf, Austria). Biophysik; 8: No. 2, 88-95(1972).

In the first part of our studies, DNA sedimentation behavior during a mitotic cycle of the unicellular green alga Chlorella pyrenoidosa was investigated. In the S-phase a decrease in sedimentation rate of alkaline-denatured DNA could be observed. Alkaline sucrose density gradient analysis was used to examine the repair of radiation-induced single strand breaks in DNA in various stages of the cell cycle. Three characteristic phases of the growth period were chosen: autospore phase, early beginning of DNA replication, and maximum DNA synthesis. Our results indicate that DNA damage is different within the cell cycle, but the repair of radiation-induced DNA strand scissions is only to a small degree dependent on the cell stage. (auth)

36328 ACTION OF IONIZING RADIATION OF THE SYNTHESIS OR RNA AND TWO INDUCIBLE ENZYMES IN ESCHERICHIA COLI. Pollard, E. C.; Lydersen, B. K. (Pennsylvania State Univ., University Park). Contract AT(11-1)-3411. Radiat. Res.; 50: No. 2, 293-300(May 1972).

The effect of gamma irradiation on the synthesis of RNA and selected proteins in Escherichia coli strain 15T–JG151 was investigated. The results showed that tRNA and ribosomes are not radically affected, whereas the two induced enzymes tested, beta-galactosidase and tryptophanase, are almost totally depressed. Significantly, the ribosomal proteins are synthesized but at least two inducible enzymes are not. In the light of recent findings suggesting different mechanisms for transcription of ribosomal RNA and mRNA for inducible enzymes, it is suggested that the process of inactivation from irradiation differs for different types of genes. (auth)

36329 TRIPLET-STATE SENSITIZATION OF THYMINE PHOTODIMERIZATION IN BACTERIOPHAGE T4. Meistrich, Marvin L.; Lamola, Angelo A. (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Mol. Biol.; 66: No. 1, 83-95(28 Apr 1972).

Triplet-state energy transfer from a suitable sensitizer specifically to thymine in the DNA of intact bacteriophage T4 leads, by the production of thymine dimers, to phage inactivation. Chromatographic analysis of radioactive DNA from sensitized phage demonstrates that thymine dimers are produced, with very low yields of other photoproducts. (auth) (UK)

36330 INVESTIGATION OF THE DENATURATION EFFECT OF LARGE DOSES OF GAMMA RAYS UPON THE VEGETAL GLOBULINS ISOLATED FROM SUNFLOWER SEEDS. Svestarova, M.; Stefanowa, M.; Atmadzov, P. (Higher Medical Inst., Plovdiv, Bulgaria. Higher Agricultural Inst., Plovdiv, Bulgaria). Folia Med. (Plovdiv); 12: No. 5, 292-301(1970).

The denaturation of two globulin preparations isolated from sunflower seeds, provoked by the effect of large doses of gamma rays, 1×10^6, 6×10^6 and 20×10^6 rad has been investigated. The solubility, viscosity, electroconductivity and UV and IR absorption spectra of native and irradiated preparations have been studied. The results show that denaturation changes increasing with the increase of the doses have appeared in the two globulins even at doses of 1×10^6 rad. At a dose of irradiation of 20×10^6 rad the conformation is changed into untidy sphere. (auth)

36331 NATURE OF RESIDUAL ESCHERICHIA COLI DNA AFTER DEGRADATION INDUCED BY IONIZING RADIATION. Rake, Adrian V.; Pollard, Ernest C. (Pennsylvania State Univ., University Park). Contract AT(30-1)-2804. Radiat. Res.; 50: No. 2, 334-8(May 1972).

The nature of DNA projected by defective prophage against degradation induced by ionizing radiation is investigated in several E. coli strains. From studies on the rate of renaturation of the residual DNA, we conclude that this DNA is a random sample of the original bacterial genome without any selection of a gene sequence resistant to degradation. (auth)

36332 REPAIR REPLICATION IN ESCHERICHIA COLI AS MEASURED BY THE PHOTOLYSIS OF BROMODEOXYURIDINE. Ley, R. D.; Setlow, R. B. (Univ. of Tennessee, Knoxville. Oak Ridge National Lab., Tenn.). Biophys. J.; 12: No. 4, 420-31 (Apr 1972).

The ability to selectively photolyze bromouracil-(BrUra-) containing repaired regions in cellular DNA has allowed us to estimate the average size of repaired regions in ultraviolet (uv) light-irradiated Escherichia coli. Cells were labeled with thymidine-^{3}H, irradiated at 254 nm, and incubated in nonradioactive bromodeoxyuridine (BrdUrd). After incubation the cells were exposed to 10^6 ergs $\cdot$ mm^{-2} at 313 nm, lysed, and sedimented in alkaline sucrose gradients so as to measure the average molecular weight of single DNA strands. In strains that had excised $\sim$45 cyclobutane pyrimidine dimers/10^8 daltons, the 313 nm treatment resulted in $\sim$6 single-strand breaks/10^8 daltons. In an excisionless strain, the same treatment resulted in only 1.5 breaks/10^8 daltons. From the determination of the sensitivities of fully substituted DNAs to 313 nm light, we calculate that the repaired regions in excising strains of E. coli contain an average of 4–6 BrUra residues. Photoreactivation experiments indicate that the excision of pyrimidine dimers in the presence of BrdUrd is the primary source of repaired regions selectively photolyzed by 313 nm radiation. (auth)

Radiation Effects on Cells (External Source)

Refer also to abstract 37736.

36333 (AEC-tr-7304, pp 59-65) INVESTIGATION OF THE CYTOGENETIC EFFECT OF THE COMBINED INFLUENCE OF X RAYS AND THIOTEPA IN CELLS OF HUMAN EMBRYOS, CULTURED IN VITRO. Korotkikh, I. M.; Tarasov, V. A. (Inst. of General Genetics, Moscow). Translated from Radiobiologiya; 11: No. 4, 528-32(1971).

A culture of human embryonic tissue was subjected to x irradiation, and an hour after this was treated with thioTEPA in concentrations of $3 \cdot 10^{-5}$, $1 \cdot 10^{-4}$, and $3 \cdot 10^{-4}$ M. The damage to the chromosomes was determined in the stages of the anaphase and early telophase of mitosis. Under the combined influence of x rays and all the tested concentrations of thioTEPA at all periods of fixation, an increase in the cytogenetic effect was observed in comparison with the summary action. The maximum increase in the effect was noted in the first day of fixation. (tr-auth)

36334 CINEMICROGRAPHIC AND PHOTOGRAPHIC OBSERVATIONS OF HeLa CELLS IRRADIATED WITH X RAYS AND FAST NEUTRONS. Sasaki, Hiroshi; Yoshinaga, Haruma (Kyushu Univ., Fukuoka). J. Radiat. Res.; 12: No. 3-4, 117-27(Sep-Dec 1971).

The fate of HeLa cells irradiated with x rays and fast neutrons was followed by cine and continual photographic procedures. The following observations were made through detailed analysis of the films. No differences could be observed between x- and neutron-irradiated cells as to the types of cell abnormalities as well as modes of cell disintegration. Cell fusion played an important role in reproductive cell death. Furthermore, cell fusion was observed between cells other than sisters, cousins, aunts, or nieces. In the pedigree of cells with colony-forming ability, there was a tendency for both cell death and normal cell division to occur in clusters of closely-related cells. (auth)

36335 INABILITY OF UV-IRRADIATED LYMPHOCYTES TO STIMULATE ALLOGENEIC CELLS IN MIXED LYMPHOCYTE CULTURE. Lindahl-Kiessling, K.; Saefwenberg, J. (Univ. of Uppsala. University Hospital, Uppsala). Int. Arch. Allergy Appl. Immunol.; 41: 670-8(1971).

Cells exposed to uv light are not able to induce DNA synthesis in allogeneic cells. HL-A typing before and after irradiation gives identical results. It is suggested that active cell metabolism and not only disparity of cell surface antigens is necessary to provoke the mixed leukocyte culture reaction. (auth)

36336 PATTERN OF DAMAGES OF CHROMOSOMES FROM CULTURED AMPHIBIAN LEUCOCYTES AFTER X-IRRADIATION OF CELLS AT DIFFERENT STAGES OF THE CELL CYCLE. I. X-IRRADIATION OF G_2 CELLS. Pankova, N. V. (Inst. of Developmental Biology, Moscow). Genetika; 8: No. 3, 52-60(Mar 1972). (In Russian).

The work deals with the analysis of chromosome aberrations occurring in grown in vitro frog leukocytes after x irradiation of blood (at a dose of 50 R) at G_2 phase of the cell cycle. The results obtained were compared with literature data concerning plant material treated at the same phase. 2621 metaphases were analyzed. Single tip deletions were the most frequent, which constituted 64% of total chromosome damages. It exceeded 5 times the value of isochromatid fragments (12.4%). In contrast, in the plant material isochromatid deletions prevailed, their number being 2–3 times as high as that of single chromatid fragments. Low frequency of fragment unions at isolocus breaks (24%) as compared to plants (97%) was also characteristic for aberrations in frog cells. It was shown that the frequency of incomplete unions is rather high (50%), while in plants the formation of translocations was usually accompanied by 100% frequency of fragment unions. Characteristics of chromosome aberrations described suggest that anaphase chromatid bridges are of different origin in plants and animals. In plants, chromatid bridges are mostly of isochromatid origin, while in animals the main source of the bridges are chromatid translocations, i.e., chromatid bridges are formed by chromatides from different chromosomes in the caryotype. (auth)

36337 CYTOGENETIC STUDIES ON LYMPHOCYTIC CULTURES FROM HUMAN PERIPHERAL BLOOD, IRRADIATED WITH PROTONS AND X RAYS. Grigoriev, Yu.; Rizov, N.; Todorov, S.; (and others). Rentgenol. Radiol.; 9: No. 4, 225-33 (1970). (In Russian).

Experimental data obtained by irradiating lymphocytic cultures from human peripheral blood with protons and x rays is reported. Doses from 25 to 500 rad were used both for the x and for the proton irradiation. They were applied in vitro on fresh heparinized blood of healthy donors. Various types of chromosomal aberrations, chromatidins and chromosomal fragments, dicentrics and other chromosomal anomalies served as basic criteria of the injury induced by the applied doses of x and proton radiation. The results are presented in 4 tables and 9 graphs; these served to deduce the principal numerical data on the aberrations induced by either type of irradiation per cell and per roentgen. A comparative analysis is made of the chromosomal aberrations resulting from the different doses of roentgen and proton radiation. The results of this analysis are interpreted. (Abstr. Bulg. Med. Sci. Lit.)

36338 ALTERATIONS IN GROWTH PROPERTIES AND VIRUS SENSITIVITY OF L-M CELLS FOLLOWING CONTINUOUS LOW-LEVEL GAMMA IRRADIATION. Gardiner, G. R.; Shipman, C. Jr. (Univ. of Michigan, Ann Arbor). Radiat. Res.; 50: No. 2, 358-78(May 1972).

Monolayers of L–M cells were exposed to continuous ^{60}Co γ-irradiation. Cellular response was measured in terms of population doubling time, viability, protein content, maximum population density, susceptibility to herpes simplex virus (HSV) infection, and uptake of extracellular components. The maximum exposure rate used was 4.7 R/hour. The population doubling times of control and irradiated cells were essentially the same although the viability of the irradiated cultures was slightly lower and the lag period longer than control values. The mean and modal cell volumes of irradiated cultures were 25–30% greater by the end of the growth period and total cell number 30% lower than control cultures at this time period. Irradiated cultures infected with HSV were more sensitive than controls in terms of number of plaques formed and infectious virus yield. This difference disappeared within 48 hours after cessation of irradiation. The uptake of colloidal gold and the adsorption of HSV by irradiated and control cells were measured. Intracellular potassium concentrations were also compared. Evidence presented suggests that the cell membrane is the primary site of radiation damage. The possibility that free radicals formed by water radiolysis induce membrane alterations is discussed. (auth)

36339 RADIATION-INDUCED DIVISION DELAY IN SYNCHRONIZED CHINESE HAMSTER OVARY CELLS IN MONOLAYER CULTURE. Leeper, Dennis B.; Schneiderman, Martin H.; Dewey, William C. (Colorado State Univ., Fort Collins). Radiat. Res.; 50: No. 2, 401-17(May 1972).

Chinese hamster ovary cells in monolayer culture, synchronized by mechanically selecting mitotic cells in the absence of drugs, were x-irradiated with 150, 300, or 600 rads at frequent intervals during the cell cycle and examined visually until completion of the first wave of cell division. The synchronized populations consisted of greater than 90% mitotic cells and their subsequent distribution throughout the cycle was carefully documented. At each time-dose combination, growth curves were analyzed for division delay (first, mean, and last cells to divide), the fraction of cells completing the first division, and the duration of the division wave. Results showed that radiation-induced division delay increased exponentially with cell age between early-mid G_1 (0.29 minute/rad) and late S-early G_2, (0.80 minute/rad) and linearly with dose at any given position in the cell cycle. Mitotic cells were more sensitive than mid-G_1 cells (0.43 vs. 0.29 minute/rad) and the increase in sensitivity leveled off in G_2 at 0.78 minute/rad. Asynchronous populations displayed the same sensitivity as G_2 cells. The fraction of cells completing the first division was reduced from about 90% for 150 rads to about 65% for 600 rads, and as for lethality, mitotic cells were most sensitive. The duration of the division waves (4.1–5.4 hours in controls) increased slightly with the greatest increase (2.1 hours) observed in S cells receiving 600 rads. (auth)

Radiation Effects on Microorganisms (External Source)

Refer also to abstracts 36327 and 36372.

36340 (AEC-tr-7304, pp 205-9) CHARACTERISTICS OF A CHLORELLA CULTURE IN THE TRANSITIONAL PERIOD OF INCREASE IN OPTICAL DENSITY AFTER IRRADIATION. Sakovich, I. S. Translated from Radiobiologiya; 11: No. 4, 633-5(1971).

All the postradiation changes in a Chlorella culture occur in the transitional period of increase in optical density of the biomass. During this period a temporary decrease in the number of viable cells is observed in the suspension, an increase in their size, and a certain synchronization of the culture. At the end of the transitional period, all the changes disappear and the culture returns to the initial state. (tr-auth)

36341 PROBLEMS OF RADIOSENSITIZATION IN EXPERIMENTAL ONCOLOGY. Ciaranfi, E.; Castellani, A. (Univ., Milan. CNEN-CSN, Rome). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 41-56(1970). (In Italian).

From National conference of the Italian Association of Medical Radiology; Rome, Italy (13 Dec 1969).

L-erythro-α, β, dihydroxybutyraldehyde, which condenses with cysteine to give thiazolidin-4-carboxylic acid and prevents the combination of mRNA with ribosomes, has been tested as a radiosensitizing agent. A radiosensitizing effect of the aldehyde on E. coli B. and E. coli B/r is reported. Ehrlich ascites adenocarcinoma cells, treated in vitro for 30 minutes with 5 mmoles aldehyde, irradiated with non-sterilizing doses of x rays (950 and 2340 rad in air or nitrogen, respectively) and inoculated intraperitoneally in SWISS/CAS rats, never produced tumors. The aldehyde had no effect on tumor cells survival at this concentration. The radiosensitizing effect described was obtained only if the aldehyde was present during the irradiation. It does not seem that immunological phenomena play an important role in the death of the neoplastic cells. In fact, increasing doses of tumor cells (from 10^2 to 10^6) inoculated alone or together with aldehyde and x ray pretreated cells gave rise to tumors also. (auth)

36342 EFFECTS OF COUMARIN, PYRONIN Y, 6,9-DIMETHYL 2-METHYLTHIOPURINE, AND CAFFEINE ON EXCISION REPAIR AND RECOMBINATION REPAIR IN ESCHERICHIA COLI. Grigg, G. W. (CSIRO, Epping, Australia). J. Gen. Mircrobiol.; 70: Pt. 2, 221-30(Apr 1972).

Pyronin Y (0.06 and 0.16 mM), coumarin (2 and 4 mM), 6,9-dimethyl 2-methylthiopurine (2 mM) and caffeine (8 mM), strongly inhibited Uvr repair (presumed excision repair) of uv lesions in Escherichia coli. With 0.16 mM-pyronin Y or 4 mM-coumarin, one thymine dimer was a lethal event in the K12 strain JC2926 rec A-13 and one to three dimers in the B/r derivative WP-2 rec A-13 and the B exr A derivative BS-2. Neither these compounds nor 8 mM-caffeine had a significant effect on the survival of irradiated bacteria of the corresponding uvr strains WP-2 Hcr$^-$, BS-12, and BS-8. It was suggested that 8 mM-caffeine, 0.16 mM-pyronin Y, 4 mM-coumarin and 2 mM-6,9-dimethyl 2-methylthiopurine selectively block excision repair without substantially affecting recombination repair. Caffeine at 12 mM only slightly depressed the viability of a uv-irradiated culture of WP-2 Hcr$^-$ or BS-12, but at 16 mM there was a much greater effect, particularly at low uv doses (<40 ergs/mm^2). Since excision repair appeared to be effectively blocked by 8 mM-caffeine, the depression of uv survival of the uvr mutants by 16 mM-caffeine was presumed to be due to interference with recombination repair. (UK)

36343 CONTRIBUTION OF THYMINE DIMERS TO THE ULTRAVIOLET LIGHT INACTIVATION OF MUTANTS OF BACTERIOPHAGE T4. Meistrich, Marvin L. (Bell Telephone Labs. Inc., Murray Hill, N. J. Ontario Cancer Inst., Toronto). J. Mol. Biol.; 66: No. 1, 97-106(28 Apr 1972).

The role of thymine dimers in bacteriophage inactivation was investigated. Sensitized irradiation was used to selectively produce the dimers in the DNA of viable T4 phage with very low yields of other uv photoproducts. Measurements of the relative inactivation rates and the photoreactivable sectors, and calculations of the yield of thymine dimers per lethal hit for both uv and sensitized irradiation were made on four mutants of T4 with different uv sensitivities. Photoreactivation, v-gene reactivation, and the yield of thymine dimers per lethal hit were all greater with sensitized irradiation than with uv irradiation but the extent of x-gene reactivation was the same with both irradiation methods. Since sensitized irradiation produces lower yields of photoproducts other than thymine dimers, it is concluded that thymine dimers act as lethal lesions in T4 phage, other lethal photoproducts are also produced by uv irradiation, the thymine dimer is the principal uv photoproduct repaired by both photoreactivation and v-gene reactivation, and the lethal effects of thymine dimers and other uv lesions are both reversed by x-gene reactivation. (auth) (UK)

36344 FORMATION AND REPAIR OF γ-RAY INDUCED THYMINE DAMAGE IN MICROCOCCUS RADIODURANS. Hariharan, P. V.; Cerutti, P. A. (Univ. of Florida, Gainesville). J. Mol. Biol.; 66: No. 1, 65-81(28 Apr 1972).

A reductive assay for the identification and determination of the major radiolysis products of thymine and its derivatives was developed. Radiolysis products of the 6-(hydroxy or hydroperoxy)-5,6-dihydrothymine type (t†) are reductively cleaved with NaBH$_4$ and a four-carbon alcohol is released containing the thymine-methyl substituent. If thymine derivatives carrying a radioactive label in the methyl group are used as starting materials for the radiolysis, the amount of the four-carbon fragments produced by the treatment with NaBH$_4$ (mostly 2-methyl-glycerol after irradiation in air) can be determined by radioactivity measurements and is a measure of the extent of thymine radiolysis. The formation and repair of thymine base damage was investigated in Micrococcus radiodurans after exposure to γ rays with the help of the reductive assay. The radiolysis products of thymine were determined in the cytoplasm and the culture medium after their release from the DNA during post-irradiation incubation. Damaged residues are released from the DNA of irradiated M. radiodurans into cytoplasm and medium during post-irradiation incubation in a biphasic, selective process. On the average, about 300 undamaged thymine residues are removed from the DNA per damaged residue during 240 minutes post-irradiation repair after irradiation in air. The first phase of removal (0 to 30 min at 37°C) and post-irradiation degradation may be part of the same process. Selectivity of product removal may be due to product clustering. Degradation is assumed to start at nearby radiation induced breaks. After a temporary halt, a second phase of product removal is observed (60 to 200 min). (auth) (UK)

36345 EFFECT OF GENE-SPECIFIC SUPPRESSOR SU α ON UV-SENSITIVITY OF AMBER MUTANTS IN GENES 46 AND 47 OF T4B PHAGE. Azizbekyan, R. R.; Krylov, V. N. (Inst. of Genetics of Microorganisms, Moscow). Genetika; 8: No. 3, 101-4 (Mar 1972). (In Russian).

Effect of intergenic specific suppressor su α on the yield and uv-sensitivity of amber mutants in genes 46 and 47 of T4B phage was studied; mutants developed under non-permissive conditions. Level of suppression as estimated from the yield was the same for amber mutants in both genes 46 and 47. Efficiency of suppression of a double amber mutant did not differ from that of the mutant for only one gene. Suppressor mutation increased considerably the uv-resistance of amber mutants, when uv-treated phage was plated on a non-permissive strain. The reproductive function of phages (the yield) in the presence of a suppressor is restored relatively better than the reparative function (uv-resistance). (auth)

36346 RADIATION STERILIZATION: MICROBIOLOGICAL FINDINGS FROM SUBPROCESS DOSE TREATMENT OF DISPOSABLE PLASTIC SYRINGES. Ley, F. J. (Atomic Energy Research Establishment, Harwell, Eng.); Winsley, B.; Harbord, P.; Keall, A.; Summers, T. J. Appl. Bacteriol.; 35: No. 1, 53-61 (Mar 1972).

Disposable plastic hypodermic syringes were taken weekly from commercial production, immediately prior to radiation sterilization, at each of three firms. They were irradiated at doses less than that used for sterilization, either with electrons or gamma rays, and tested for sterility. The relationship between the dose applied and the resulting proportion of syringes positive was similar for each firm. Among the organisms surviving subnormal process doses was a yeast of unusually high radiation resistance. The possibility of establishing a microbiological quality control procedure based on the routine use of a subprocess dose technique is discussed. (auth)

36347 STIMULATION OF THE GROWTH OF CHLORELLA PYRENOIDOSA BY CONTINUOUS IRRADIATION WITH ULTRAVIOLET OF LOW INTENSITY. Brandt, A. B.; Krylov, V. A. (Inst. of Biological Physics, Moscow). Biophysics (USSR) (Engl. Transl.); 16: No. 4, 760-3(1971).

Continuous irradiation of a suspension of Chlorella pyrenoidosa with a radiant flux with a power of 6 mW/m^2 from a PIK-4 lamp plus a luminosity of 80 W/m^2 produced by the DS-30 luminescence lamps caused acceleration of increase in the optical density of the suspension, compared with the control, indicating the stimulatory effect of continuous irradiation with ultraviolet of low intensity on the growth and development of Chlorella pyrenoidosa. (UK)

36348 STUDIES ON THE PRESERVATION OF KOREAN RICE BY GAMMA-RADIATION. IV. ON THE FREE AMINO ACIDS CONTENTS IN GAMMA-IRRADIATED RICE. Kim, Hyong Soo; Kim, Sung Kih; Harn, In Ja. Han'guk Sikp'um Kwahakhoe Chi; 3: No. 1, 15-18(1971).

Previous reports discussed the chemical and biological changes in gamma-irradiated polished and brown Korean rice stored at room temperature. Free amino acids are related to the taste of rice. Therefore, the developing changes in the free amino acids of gamma-irradiated rice were traced using the amino acid autoanalyzer. Kondo and Sasaoka detected 19 kinds of amino acids and in 1970, Tajima et al. sampled polished and brown rice of the Japanese Koshihikari variety and examined the contents of free amino acid in them during storage following 20 to 90 Krad irradiation by ^{60}Co. (Korean Sci. Abstr.)

36349 STUDIES ON THE PRESERVATION OF KOREAN RICE BY GAMMA-RADIATION. V. EFFECT OF LOW TEMPERATURE STORAGE OF GAMMA-IRRADIATED RICE. Kim, Hyong Soo; Kim, Sung Kih. Han'guk Sikp'um Kwahakhoe Chi; 3: No. 1, 19-24(1971).

In previous reports, the effectiveness of low-levels of irradiation for disinfestation was reported, confirming that no critical biological changes occurred in Korean polished and brown rice treated with gamma-rays and stored at room temperature. In this investigation, changes in the fatty acids, amylase activity, viscosity, and organoleptic properties were investigated in rice samples stored at 10°C and 75% relative humidity (RH) after gamma irradiation. The rice stored at low temperatures acquires a sterilizing effect against the disinfestation and disinfection. Tani et al. and Chikubu et al., having stored the rice at 10° to 13°C with 70 to 80% RH, found a decreasing rate of amylase activity and viscosity, and an increase in fatty acids in the first year in comparison with room temperature storage. This was the only exceptional case, otherwise low temperature storage generally conveyed less changes of the contents than room temperature storage. (Korean Sci. Abstr.)

36350 CORRELATIONS BETWEEN SENSITIVITIES TO RADIATION AND TO HYPEROXIA IN MICROORGANISMS. Brown, Olen R. (Univ. of Missouri, Columbia). Radiat. Res.; 50: No. 2, 309-18(May 1972).

The bactericidal and bacteriostatic effects of hyperoxia from 1 to 15 atm and from 1 to 4 atm, respectively, were measured for Escherichia coli strains E-26, B, B/r, and B_{s-1}. Percentage survival was minimal for all strains in oxygen (O_2) at 4.2 atm (E-26, 51%; B, 1.5%; B/r, 60%; and B_{s-1}, 0.25%). O_2 at 1 − 2 atm produced little killing and O_2 at 6 atm or greater was less bactericidal than was 3 − 5 atm. Strain B/r survived better in all hyperoxic environments than did strain B or B_{s-1}. Survival of E-26 and Micrococcus radiodurans at 4.2 atm O_2 was similar to B/r. When B_{s-1} was exposed to O_2 at 4.2 atm without organic nutrients, 66% survived. During the first hour of exposure, the growth rate of strain B/r was inhibited 13.2% per atm O_2 with an extrapolated intercept of 100% survival at 0.6 atm; growth inhibition of B_{s-1} was 12.2% per atm with an intercept of 1.2 atm. We concluded that: strains B and B_{s-1}, which are radiation sensitive, were also more sensitive to the bactericidal effect of hyperoxia than was strain B/r, which is radiation resistant; however, strain B/r was not more resistant to O_2 than strain E-26 which has no unusual radiation resistance; growth and synthesis potential in hyperoxia were required for the bactericidal effect. (auth)

36351 DNA STRAND BREAKAGE AND BIOLOGICAL FUNCTIONS OF HUMAN ADENOVIRUS AFTER GAMMA IRRADIATION. Rainbow, Andrew J.; Mak, Stanley (McMaster Univ., Hamilton, Ont.). Radiat. Res.; 50: No. 2, 319-33(May 1972).

Human adenovirus type 2 was irradiated with gamma rays and the radiosensitivity of several viral functions was determined and correlated with the damages in the viral DNA. The D_{37} for plaque formation, including body formation, and inhibition of cell cloning was found to be 0.46, 0.54, and 0.75×10^6 rads, respectively. Radiation induced 0.5 single-strand breaks and 0.01 double-strand breaks per rad per 10^{12} daltons in the viral DNA. For the adsorbed virus, an average of 8.1 single-strand breaks and 0.16 double-strand breaks were induced in the viral DNA per inactivation of the plaque-forming ability. This suggested that the single-strand breaks may be repaired. No rejoining of broken DNA molecules could be detected after infecting cells with the irradiated virus at high multiplicity of infection. On the contrary, additional single-strand nicks were detected after infecting a host cell. (auth)

36352 EFFECT OF GAMMA RAYS OF ^{60}Co ON THE ACID-FORMING PROPERTIES OF THERMOPHILIC LACTIC ACID BACTERIA. Mirganieva, M. Uzb. Biol. Zh.; No. 5, 11-13 (1971). (In Russian).

The lactic acid bacterium, Lactobacillus thermophilus, was irradiated at doses ranging from 1 to 155 kR with a ^{60}Co γ source. A significant fraction of the bacteria were killed, and the fermenting capability was reduced, the activity varying inversely with the intensity of the dose. (K.S.W.)

36353 RADIOSENSITIZATION AND PHENOLIC AND QUINONIC RADIOSENSITIZERS. Ramos Avila, Elena Leonor. Arch. Inst. Farmacol. Exp. (Madrid); 21: 69-100(1969). (In Spanish).

In phenolic and quinonic compounds the process of oxyreduction comprises two successive electronic transferences and involves the formation of free radicals of the semi-quinone type. The stability of these radicals depends on the pH of the medium where Redox equilibria is determined by processes of acceptance of electrones, whose mechanism may be very important in radiosensitization. Taking these properties as the basis, six compounds of the phenolic and quinonic type were selected for study: three diphenols of bencene, 1 : 3 dihydroxinaphthalene, p-quinone, and 1 : 2-naphthoquinone-4-sulphonic acid Na salt. These were applied to haploid cultures of Saccharomyces cerevisiae. The toxicity of the products for yeast cultures was determined by applying nine doses comprising: 0, 6.25, 12.50, 25, 60, 100, 150, 200, and 250 μg. The toxicity of x radiation was determined by applying ten doses to the cultures: 0, 10, 15, 20, 30, 40, 60, 80, 90, 100, and 120 Krad. In both cases the DL_{50} was selected. When the toxicity of the compounds was studied, using the curve dose-response, five of them showed paradoxical effects and the possible causes of these anomalous effects are examined. In further experiments, work was carried out on the combined effects of the two agents; product and radiation, applying the respective doses in the following form: x radiation doses of 0, 7.5, 15, 22.5 Krads and product doses of 34, 25.5, 17, 8.5, and 0 μg. From the experimental values found in each combination, the potential factor for sterilization using each product was determined. (TSS)

Radiation Effects on Plants (External Source)

Refer also to abstract 36400.

36354 (AEC-tr-7304, pp 121-6) BIOLOGICAL EFFECTS OF PROTONS AND GAMMA RADIATION ON WATERCRESS SEEDS. Gertsuskii, D. F.; Alekseenko, L. V. Translated from Radiobiologiya; 11: No. 4, 575-9(1971).

The dose versus effect dependences of 660 MeV protons and the gamma radiation of ^{60}Co were studied for watercress after preplanting irradiation of the seeds. It was shown that comparatively small doses of these types of radiation are responsible for some stimulation of the processes of vital activity of the plants, while higher doses have an inhibiting effect. Lethal doses of protons and gamma radiation for watercress (with respect to survival and yield of plants) only slightly exceeds 100 and 200 krad, respectively. The RBE coefficient of protons according to agrobiological criteria of evaluation, increases as the dose is increased from one to two and more. A correlation is noted between the rate of growth of the primary rootlets, the development and viability of the plants. (tr-auth)

36355 (AEC-tr-7304, pp 127-36) DYNAMICS OF RADIATION DAMAGE TO THE PLANT ORGANISM WITH LESSER DUCKWEED AS AN EXAMPLE. Kasinov, V. B.; Kasinova, G. V. (Ioffe Inst. of Physics and Tech., Leningrad). Translated from Radiobiologiya; 11: No. 4, 580-6(1971).

The dynamics of radiation damage to lesser duckweed was investigated with a nondichotomous system of registration of vegetative progeny (pedigree), which can be used in all cases when it is possible to distinguish between the parent and daughter living system during development or vegetative reproduction. A method is proposed for calculating the independent death rate—a new index, reflecting the direct action of radiation on phytomeres of primordia of various ages. Using this index, the natural degree of preformism, characteristic of a duckweed colony, was determined quantitatively. The criteria of the dynamics of radiation damage were the length of the mature individual, the total and independent death rates. The shape of the corresponding curves reflects differences in the radiosensitivity of the phytomeres of different ages and their very presence at the moment of irradiation. The absence of a stimulating effect of small doses of X rays on the length of the individuals and the survival of lesser duckweed was detected. (tr-auth)

36356 (AEC-tr–7304, pp 137-48) INFLUENCE OF THE CONDITIONS OF NUTRITION OF PLANTS ON THE MODIFICATION OF THE RADIOBIOLOGICAL EFFECTS IN WHEAT AFTER PHASED CHRONIC IRRADIATION. Il'ina, G. V.; Kuznetsova, N. N. (Moscow State Univ.). Translated from Radiobiologiya; 11: No. 4, 587-94(1971).

In experiments with cultivation of wheat on a gamma field at various periods of vegetation, the effect of chronic irradiation depended both on the stage of development of the plants and on the conditions of nutrition. Intensive irradiation of the plants (dose rate 2 R/hr) during the period of germination to tillering caused an appreciable decrease in the size of the spike, high sterility, and in certain cases a reduction of the yield of grain. When wheat was irradiated at later periods, no negative influence of radiation on the productivity of the plants was observed. (tr-auth)

36357 (AEC-tr–7304, pp 196-200) INFLUENCE OF UV AND X RAY IRRADIATION ON THE ULTRAWEAK CHEMILUMINESCENCE OF PEA SPROUTS. Veselova, T. V.; Veselovskii, V. A. (Moscow State Univ.). Translated from Radiobiologiya; 11: No. 4, 627-30(1971).

The influence of and irradiation on the ultraweak chemiluminescence of the root system of pea sprouts was studied. In the case of uv (0.25 to 1.5 hrs) and x ray (200 to 800 rad) irradiation, the ultraweak luminescence of the seedlings increases; increasing the dose of irradiation leads to inhibition of the luminescence. The kinetic principles of the luminescence of healthy and irradiated plants do not differ, which indicates identity of the products participating in the chemiluminescence reaction. It is hypothesized that the activation of the luminescence of the sprouts during irradiation is associated with the accumulation and breakdown of peroxides as a result of the activity of lipoxidase and peroxidase. (tr-auth)

36358 (AEC-tr–7304, pp 201-4) CHANGE IN THE RADIOSENSITIVITY OF PLANTS AS A RESULT OF PRELIMINARY RADIATION INFLUENCE. Kulikov, N. V.; Al'shits, L. K.; Pozolotin, A. A.; Tarchevskaya, S. V. (Inst. of Ecology of Plants and Animals, Sverdlovsk, USSR). Translated from Radiobiologiya; 11: No. 4, 630-32(1971).

In experiments with pea and Scotch pine seeds it was established that preliminary irradiation of the seeds with the gamma rays of ^{60}Co at low doses reduces their radiosensitivity to a repeated radiation influence. It is believed that the radiobiological effects of radiostimulation and increased radioresistance of plants under the influence of irradiation at low doses are regulated by a single mechanism. (tr-auth)

36359 (AEC-tr–7304, pp 210-12) EFFECTS OF PREPLANTING GAMMA IRRADIATION ON FEIJOA SEEDS. Akhund-Zade, I. M.; Imamaliev, G. N. (Inst. of Genetics and Selection, Baku). Translated from Radiobiologiya; 11: No. 4, 636-7(1971).

Under the conditions of Azerbaydzhan, the lethal dose of gamma irradiation for feijoa proved to be 32 kR, the critical dose 16 kR. Stimulating doses of gamma rays for feijoa were 0.5, 1, and 2 kR, at which growth of the above-ground and underground portions significantly exceeds the control. Preplanting gamma irradiation of feijoa seeds in a dose of 1 kR in nurseries is recommended. (tr-auth)

36360 ALTERATIONS IN NUCLEIC ACID CONTENT AND RNase ACTIVITY IN THE COURSE OF GERMINATION OF ^{60}Co IRRADIATED SOYBEANS. Lee, Ki Yung; Kim, Han Seob; Cheon, Hyeong Won; Choi, Young Jo; Ahn, Hyun Jin. Korean Biochem. J.; 2: No. 1, 19-34(1969). (In Korean).

Gamma rays from a ^{60}Co source in a dose of 230 KR were administered to dry as well as to previously soaked soybean seeds. The germination and seedling growth of dry beans was arrested by 50%, whereas that of soaked ones 67%, which was equivalent to what would be seen in 500 KR dry irradiated seedlings. In the course of 7-day growth and maturation of seedlings, the DNA and RNA contents per embryo or per unit grain of gamma irradiated dry seeds were reduced by 50 and 57%, respectively, and those of soaked and irradiated group 76% and 75%, respectively. These changes in nucleic acid content as well as those in ascorbic acid and lipid and acid soluble-phosphorus were all consistent with the germination and growth pattern of the irradiated soaked or dry seeds. The RNase activity of soaked and irradiated soybeans was characteristically different from that of the dry irradiated one as well as the control. Differences between the irradiated soaked and dry soybeans in relation to the indirect effect of radiation via water molecules imbibed were discussed. (Korean Sci. Abstr.)

36361 MORPHOLOGICAL VARIATIONS IN MUNG (PHASEOLUS AUREUS) INDUCED BY GAMMA IRRADIATION. Rajput, Mushtaque Ahmed (Radiation Genetics Inst., Lyallpur, India). Pak. J. Sci. Ind. Res.; 14: No. 4-5, 400(Aug-Oct 1971).

Seeds of two pure varieties of Phaseolus aureus were exposed to 10 to 40 kR doses of gamma radiation from a ^{60}Co source. Ten days later irradiated seeds were sown in the field. At pod formation stage, abnormalities in leaves were noted and growth was stunted. It is suggested that phenotypic abnormalities are manifestations of physiological disturbances of cell materials. (H.L.W.)

36362 MORPHOLOGICAL VARIABILITY OF VINE UNDER THE EFFECT OF X-RAYS. Soldatov, P. K.; Aleksan'yan, A. K. (Samarkand State Univ., USSR). Tsitol. Genet.; 5: No. 6, 505-11(Nov-Dec 1971). (In Russian).

With an increase in x-ray treatment of two-eyed and normal grape vine cuttings, their ability to take roots was lower. The preliminary soaking of the cuttings considerably increased the radiation effect up to the lethal dose. The ordinary soil medium fertility at the plot showed no differences between the variants of irradiation and control as to the medium length of the shoot and its ripened part on the seedling. On a high soil medium fertility, the dose of 500 R stimulated the growth of shoots on the seedlings, but as the dose increased up to 12,000 R the medium length of the shoot and its ripened part was lower. The frequency of morphological anomaly appearance did not correlate with the irradiation doses. The maximum deviation of $\varkappa^2$ from the standard level occurred when the dose was 3000 to 7000 R, which coincides with the previously established facts on the greatest mutagenous effectiveness of these doses for vine cuttings. The greatest quantity of anomalies resulting from x-irradiation appears in the leaf structure. (auth)

36363 EFFECTS OF GAMMA IRRADIATION ON THE CYTOPLASMIC MALE STERILE SUGAR BEETS. Kinoshita, T.; Takahashi, M. (Hokkaido Univ., Sapporo). Tensai Gijutsu Renraku Kenkyukai Happyo Ronbunshu; No. 10, 44-7(Feb 1971). (In Japanese).

The effects of γ irradiation on a cytoplasmic male sterile strain of sugar beets were studied. Atrophy and degeneration of the anthers were observed only in M_1 plants, and were considered to be a result of radiation treatment. Strongly sterile phenotypes did not appear by selective tests performed on a small scale. The test results, however, suggested some hereditary change related to the interaction of nuclear genes with cytogenes. Further investigation is necessary to determine whether that change was due to a change of phenotype. Moreover, male sterility due to chromosome abnormality or gene mutation may possibly be induced. (Japan)

36364 EFFECT OF PRE-SOWING IRRADIATION OF SEED BY GAMMA RAYS OF ^{60}Co ON MORPHOLOGICAL STRUCTURE OF COTTON PLANTS. Yuldashev, S. Kh.; Akchurina, N. A.; Domina, N. D. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 5, 37-9(1971). (In Russian).

Total doses of ^{60}Co gamma radiation of from 500 to 25,000 R were administered to dried cotton seed (variety 108-F). Within the conditions of the tests stimulation of growth and development of the cotton plants resulted. Changes in the morphological structure of the plants are described. (K.S.W.)

36365 INFLUENCE OF GAMMA RAYS OF ^{60}Co ON CHARACTERISTICS OF COTTON FIBER RESULTING FROM VARYING THE DURATION OF ILLUMINATION. Avtonomov, V. A. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 5, 50-2(1971). (In Russian).

Moistened cotton seed were irradiated with 1,000, 2,000, and 6,000 R doses of ^{60}Co γ radiation. Each of these experimental lots was divided into three groups, which were illuminated by natural daylight (controls), or artificial light for 10-hr and 24-hr lamp intervals, respectively. The irradiated seed grown under natural daylight produced longer fibers which possessed greater breaking strength. The 10-hr illuminated cotton produced a shorter fiber, and the 24-hr illuminated cotton exhibited both trends, depending on the variety tested. (K.S.W.)

36366 INFLUENCE OF GAMMA RADIATION ON THE VARIABILITY OF CHARACTERISTICS IN THE COTTON PLANT. Paiziev, P.; Egamberdiev, A. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 5, 53-5(1971). (In Russian).

Flowering cotton plants were irradiated with a gamma source to produce doses of 0.5 to 3.0 kR. The variability of characteristics of the plants depended on the physiological state of the organism at the moment of irradiation, and on the genotype of the material being studied. The size and form of the bolls, the form of the bush, the yield and length of the fiber were found to be more variable than other characteristics. (K.S.W.)

36367 CHANGE IN AMINO ACID CONTENT OF PEPTIDE FRAGMENTS OF 7 S GLOBULIN OF COTTON SEED AS A RESULT OF GAMMA IRRADIATION. Ibragimov, A. P.; Yunuskhanov, Sh. (Inst. of Biochemistry, Tashkent). Uzb. Biol. Zh.; No. 5, 56-7(1971). (In Russian).

Globulins from γ irradiated cotton seeds were assayed for amino acid content. The quantity of serine, glycine, tryosine, and phenylalanine was greater in the irradiated material than in the controls. (K.S.W.)

36368 BIOCHEMICAL FEATURES OF RADIOINDUCED MUTANTS OF COTTON PLANT. Nazirov, N. N.; Ganiev, S. G.; Perepelenko, S. D. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 6, 6-9(1971). (In Russian).

A medium-late ripening variety of cotton, a γ radioinduced mutant "RL" derived from 108-F, a wild form, and a photoperiodic radioinduced mutant derived from the wild form, were compared with respect to their tendencies to incorporate ^{14}C in various proteins in the roots of 30-day sprouts. The radioinduced mutants did not differ from their original forms in DNA or RNA content, nor in the protein content of the roots. Biosynthesis of DNA, RNA, and proteins proceeded more actively in the wild cotton plant than in the commercial variety or its mutant. (K.S.W.)

36369 INFLUENCE OF IRRADIATION ON THE GENERATIVE CENTROSPHERE OF THE COTTON PLANT AND OTHER SPECIES OF MALVACEAE. Kamalova, G. V. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 6, 45-7 (1971). (In Russian).

A histochemical method was used to study the generative organs of cotton and certain other species of Malvaceae. Dry seeds were irradiated with a ^{60}Co γ source so as to provide doses of 1, 3, 10, 20, 30, 40, and 50 kR. In Gossypium hirsutum, the larger doses disturbed bud formation, and the pollen was small and undeveloped; in H. manihot: Poorly formed buds and petals. Malva sylvestris: Plants exhibited considerable radioresistance; deviations from the norm only in the pollen. Althaea rosea: exhibited radioresistance. Fertility of pollen in most cases was 90 to 100%. (K.S.W.)

36370 EFFECT OF IRRADIATING SEEDS WITH ^{60}Co GAMMA RAYS ON CELL DIVISION IN THE MERISTEM OF ROOTS OF THE COTTON PLANT. Rumi, V. A.; Filatova, R. S. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 6, 48-51 (1971). (In Russian).

The mitotic activity of meristematic cells of cotton plant roots was studied following exposure of seeds to ^{60}Co γ radiation. Anomalous cell division and chromosome aberrations were observed. Multiple bridges in the form of thickened braids were observed in chromosomes after 10 and 20 kR; chromosome fragments were scattered about in the cytoplasm of the cell following exposure to 20 kR; and single or multiple bridges were observed following exposure to 3 and 10 kR. With increased radiation dose, mitotic activity was lowered and the number of anomalous mitoses increased. (K.S.W.)

36371 INFLUENCE OF IONIZING RADIATION ON THE FREE AMINO ACID CONTENT OF COTTON SEEDLINGS. Arslanova, S. V.; Saitmuradova, U. (Inst. of Experimental Plant Biology, Tashkent). Uzb. Biol. Zh.; No. 6, 52-4(1971). (In Russian).

Control and γ-irradiated cotton seedlings were studied with respect to their free amino acid content. The amounts of 18 individual amino acids were determined 24 and 48 hr after irradiation, and the changes in such values were strongly dependent on the variety of cotton: the quantity of glycine, valine, lysine, isolysine, and alanine increased 24 hr after irradiation in one variety (S-1622), but decreased in another variety (1306-BV). (K.S.W.)

Radiation Effects on Animals (External Source)

36372 ADVANCEMENTS IN RADIOBIOLOGY. VOLUME IV. RADIOSENSITIVITY AND RADIOSENSITIZATION OF HUMAN AND EXPERIMENTAL TUMORS. National Conference of the Italian Association of Medical Radiology, Rome, Italy, December 13, 1969. Fumagalli, Z.; Castellani, A. (eds.). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 1-99(1970). (In Italian). (CONF-691232).

Seven articles are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual papers see: 36341, 36373, 36374, and 36379–36382.

36373 RADIOSENSITIZING DRUGS. Benigno, P.; Rausa, L. (Univ., Palermo, Italy). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 11-28(1970). (In Italian).

From National conference of the Italian Association of Medical Radiology; Rome, Italy (13 Dec 1969).

The main factors capable of modifying the response of the biological substrata to ionizing radiation were analyzed, and the pharmacological properties of radiosensitizing drugs are discussed. The possibility that medicamentary molecules, not clearly defined as radiosensitizing drugs, can vary the response of the biological substrata to these physical agents in a positive or negative direction by modifying the cellular metabolism during the course of a combined treatment with ionising radiations is suggested. (auth)

36374 RADIOBIOLOGICAL AND CLINICAL ASPECTS OF TUMOR RADIOSENSITIZATION. Oliva, L. (Univ., Genoa). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 29-40(1970). (In Italian).

From National conference of the Italian Association of Medical Radiology; Rome, Italy (13 Dec 1969).

No rational attempt to tumor-radiosensitization in human clinical practice can be made without a careful evaluation of the recent radiobiological and oncological experimental acquisitions. In particular, the non-variance of intrinsic cellular radiosensitivity makes it necessary, for a satisfactory radiotherapeutic interval between the tumor center and healthy parts, to examine, above all, the different kinetic characteristics of normal and neoplastic cell populations. All the radiotherapeutic methods, based on particular chronological way of distribution of the dose of radiant energy, have to be performed taking into account the data on cell population kinetics. In the light of what is known today on cell and tissue radiosensitivity, a classification of radiosensitizing agents is proposed, considering four different levels of interference in the chain of phenomena taking place in the neoplastic tissue as a result of the absorption of radiant energy. On the basis of this analysis of tumor radiosensitization, a clinical scheme of tumor plurisensitization is experimentally proposed. (auth)

Man

Refer also to abstracts 35865, 36564, and 37735.

36375 (AEC-tr–7304, pp 71-4) PROBLEM OF INTENSIFICATION OF THE BIOLOGICAL EFFECTS OF IONIZING RADIATIONS. Yarmonenko, S. P. (Inst. of Experimental and Clinical Oncology, Moscow). Translated from Radiobiologiya; 11: No. 4, 537-9(1971).

Some theoretical problems of intensification of the radiobiological effect are discussed from the standpoint of increasing the effectiveness of radiation therapy of tumors. Considerations are expressed with respect to the fact that the traditional term radiosensitization reflects only a particular case of the entire problem and rather predetermines the mechanism of increasing radiosensitivity. Attention is concentrated on the refinement of the concept of selectivity of the action of modifying agents with respect to tumoral and normal tissues, in particular, on the necessity of investigating not only the critical organs, but also primarily the connective tissue elements of the tumor stroma. (tr-auth)

36376 (CONF-720108–2) ANIMAL RADIATION DATA AND THEIR RELEVANCE TO MAN. Walburg, Harry E. Jr. (Oak Ridge National Lab., Tenn.). [1972]. 8p. Dep. NTIS.

From Conference on research animals in medicine; Washington, D. C. (28 Jan 1972).

Problems involved in extrapolating radiobiological data from animal studies to man are reviewed. Emphasis is placed on data on the effects of whole-body exposure to external radiations on the manifestation of late somatic effects and the induction and acceleration of neoplasms. It is pointed out that animal studies show there is great variability in the type and sensitivity of radioinduced tumors in different species and among different strains of the same species. Certain qualitative generalizations on the biological effects of radiation that may be extrapolated to man are summarized. These include life shortening and the influence of radiation dose, dose rate, LET, and age at exposure on tumor induction. (C.H.)

36377 (ORNL–4720, pp 80-94) DOSIMETRY FOR HUMAN EXPOSURES AND RADIOBIOLOGY. Poston, J. W.; Auxier, J. A.; Cheka, J. S.; (and others) (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

CALIFORNIUM-252—dose distribution from external and implant sources of, used for therapy, fast neutron and γ, p. 81-82
GAMMA RADIATION—dosimetry for therapy of, from californium-252 external and implant sources, p. 81-82
MAN—neutron dose distribution in, use of phantoms for measurement of, p. 82-94
NEUTRONS, FAST—dosimetry for therapy of, from californium-252 external and implant sources, p. 81-82
  —dose distribution in cylindrical tissue equivalent phantoms, use of ${}^{1}H(n,\gamma){}^{2}H$ and ${}^{14}N(n,p){}^{14}C$ reactions for measurement of, p. 82-94
PHANTOMS—neutron dose distribution in cylindrical tissue equivalent man, rabbit, and rat, methods for measurement of, p. 82-94
  —photon dose distribution in heterogeneous cylindrical human, calculations at energies from 50 to 660 keV and 1.25 to 10 MeV, p. 85-94
PHOTONS—dose distribution in heterogenous cylindrical human phantoms, calculations at energies from 50 to 660 keV and 1.25 to 10 MeV, p. 85-94
RABBITS—neutron dose distribution in, use of phantoms for measurement of, p. 82-94
RATS—neutron dose distribution in, use of phantoms for measurement of, p. 82-94 (C.H.)

36378 (SZS-20/71) METHODS OF CLINICAL FUNCTION DIAGNOSTICS AND THEIR PRACTICAL VALUE FOR MEDICAL SUPERVISION OF OCCUPATIONALLY EXPOSED PERSONNEL. I. GENERAL ASPECTS OF THE IMPORTANCE OF CLINICAL FUNCTION DIAGNOSTICS TO RADIATION PROTECTION MEDICINE. II. METHODS OF CARDIOPULMONARY FUNCTION DIAGNOSTICS. Schuettmann, W.; Arndt, D. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Nov 1971. 37p. (In German). Dep. NTIS (U. S. Sales Only).

Diagnostic examinations are outlined that may be necessary to supplement routine examinations of radiation personnel. Suggestions are given for medical supervisors of radiation personnel concerning indications for additional examinations with particular attention to the cardiopulmonary system, the kidneys, and the liver. An outline of diagnostic procedures is also included in the instructions for medical supervisors. A review is given of diagnostic procedures for evaluating heart function, the circulatory system, and the lungs. Various examination procedures are evaluated with regard to radiation protection aspects. (H.L.W.)

36379 RADIOSENSITIVITY AND RADIOSENSITIZING OF TUMORS. Ratti, A. (Univ., Milan. Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 1-9(1970). (In Italian).

From National conference of the Italian Association of Medical Radiology; Rome, Italy (13 Dec 1969).

The exposure conditions for tumor treatment must consider nature and kind of radiation, the dose, as a measure of energy absorbed, and the mode of distribution (chronology and geometry) of radiation. The effects of ionizing radiation on cells are physical, chemical, and morphological: retardation of mitosis, inhibition of mitosis, and the death of the cell (two variations). Three avenues of approach to the problems of radiosensitivity and radiosensitization of tumors are outlined. The first is pharmaceutical research in sensitizing action on cell metabolism, not in the abiotic sense but the augmentation of cell radiosensitivity or blocking the mechanisms of natural radioprotection. A second approach could be the selective obstruction of cell recovery in the tumor. A third is an attempt to control cell population utilizing fractionated radiotherapy with various rhythms in irradiation/rest in the complex therapeutic circle. The greatest difficulty lies in clinical application, since the curves of survival and the study of dynamic equilibrium of a cell population afford reliable information, while therapeutic results are conditioned by a great number of variable factors. (K.S.W.)

36380 EFFECTS OF HEMATOPORPHYRIN ON TUMOR RADIOSENSITIVITY. Cittadini, G. (Univ., Genoa). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 57-63(1970). (In Italian).

From National conference of the Italian Association of Medical Radiology; Rome, Italy (13 Dec 1969).

A critical examination was made of some of the experimental data, both personal and otherwise, concerning three properties of hematoporphyrin of possible radiotherapeutic interest: negligible toxicity; concentration of selectivity in tumorous tissues; and radiosensitizing action on some biological substrata. The weak point in the assumption which led to hematoporphyrin treatment of patients suffering from malignant diseases, with not very encouraging results, seems to lie in the inconstant reproducibility, at the molecular and cellular levels of the radiosensitizing action observed in experiments on panirradiated animals. The reasons for the variability of Ep effect are briefly discussed and some working hypotheses on the possible mechanisms of interference in cellular radiosensitivity are proposed. (auth)

36381 RELATIONS BETWEEN IONIZING RADIATIONS AND IMMUNITY IN TUMORS. Clerici, E. (Univ., Milan). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 65-83(1970). (In Italian).

From National conference of the Italian Association of Medical Radiology; Rome, Italy (13 Dec 1969).

Following a review of data concerning the influence of ionizing radiations on both primary and secondary immune responses, evidence of the presence of Tumor-Specific Transplantation Antigens both on experimental and human neoplasms, is given. The possibility that the oncolitic effect of ionizing radiations and the specific immune response of the tumor-host may interact in order to erase the malignant cells is discussed. It is pointed out that anti-tumor antibodies, either of soluble or cellular nature, may radiosensitize the neoplasm and therefore facilitate its eradication by ionizing radiations. Data from the literature to both support and clarify the above mentioned matters are concisely reported and discussed. (auth)

36382 CLINICAL PROBLEM OF RADIOSENSITIVITY IN TUMORS. Piemonte, M. (Spedali Civili, Brescia, Italy). Med. Nucl.-Radiobiol. Lat., Suppl.; No. 4, 85-95(1970). (In Italian).

From National conference of the Italian Association of Medical Radiology; Rome, Italy (13 Dec 1969).

On the premise that the radiosensitivity of a cellular population is defined by the number of cells which, in relation to a specific dose of radiations, survive and retain the capacity to proliferate indefinitely, consideration is given to the clinical problem of radiosensitivity in tumors. In fact, from the practical point of view, the clinical problem of radiosensitivity in tumors lies in the fact that, when the radiologist makes a preliminary evaluation of the possibility of curing a neoplasia, among the elements that he considers, the clinical estimate of radiosensitivity in a radiobiological sense is certainly of considerable importance, but in formulation of the prognostic opinion there is interference of other factors, both local and general, which are not identified with radiosensitivity in the strict sense, although they are more or less closely correlated with it, and which are in any event such as to influence the response of the neoplastic tissue to irradiation in a way which is often very evident. As a result of the examination made, it was concluded that the factors likely to have an important effect on regression (understood as radiosensitivity "versus" radiocurability) of a tumor may include the following: action of the radiotherapy on the kinetics of the neoplastic cell population, characterized by the inactivation curve and by the growth fraction; presence within the tumor of necrotic, degenerate, cystic, hemorrhagic, and in any event poorly vascularised areas and degree of oxygenation of the neoplastic tissue; characteristics of the tissue from which the tumor arises, establishment and development of the blastoma; action of radiation on the stroma and on its vessels; and responses conditioned by the mechanisms of tissue and organism homeostasis. (auth)

36383 TASTE DISORDERS FOLLOWING RADIOTHERAPY IN THE HEAD-NECK REGION. Hansen, D.; Meyer, E.; Werner, H. (Univ., Kiel). HNO; 18: No. 5, 133-6(May 1970). (In German).

A group of 111 patients with malign tumors in the head and neck area was examined after radiation therapy with special regard to gustation. Impairment of gustation especially occurs when radiation involves the tongue directly, but is less often found when the tongue is not located within the radiated area. Objective findings explain the patients' complaints. The loss of the sense of taste is caused by a local reaction to radiation of the lingual area. A permanent loss of gustation was not found. Loss or impairment of olfaction or sensitivity could not be observed. (auth)

36384 RADIATION REACTIONS IN CERVICAL CANCER THERAPY. Buchler, Dolores A.; Kline, Joyce C.; Peckham, Ben M.; Boone, Max L. M.; Carr, W. F. (Univ. of Wisconsin, Madison). Amer. J. Obstet. Gynecol.; 111: No. 6, 745-50(15 Nov 1971).

Between 1961 and 1969, there were 410 patients treated for invasive squamous cell carcinoma of the cervix with either intracavitary therapy alone or in combination with external radiation. This group of patients was reviewed for reactions occurring during treatment as well as one month after completion of treatment. The reactions were subdivided into mild, moderate, and severe. As the gastrointestinal reactions became more severe, the chance for a subsequent complication increased significantly. Though patients had no problems during the course of radiation therapy, it appears a certain percent will still develop complications later. The same relationship was not observed for the genitourinary system. The majority of patients developing a genitourinary complication had no significant symptoms during the reaction period. (auth)

36385 RADIO-IODINE THERAPY TO OUT-PATIENTS: THE RADIATION HAZARD. Pochin, E. E. (University Coll. Hospital Medical School, London). Brit. J. Radiol.; 45: No. 533, 391 (May 1972).

Estimates of doses received by members of the household of out-patients treated with ^{131}I are discussed. Observations showed that an out-patient given 30 mCi would deliver an average dose at about 0.5 rad at the neck to the husband or wife, with over 1 rad in 10% of the cases. It is suggested that with doses of 100 to 150 mCi for thyroid cancer, 1 CRP limits for members of the general public would be exceeded (i.e., 0.5 rad to bone marrow or gonads). (UK)

36386 OSTEORADIONECROSIS OF THE MANDIBLE. A SUGGESTION FOR PALLIATIVE TREATMENT. Petersen, K. B. (Univ. of Western Ontario, London). J. Ont. Dent. Ass.; 48: No. 6, 176-9(Jun 1971).

A case of osteoradionecrosis of the mandible following radiotherapy of a basal cell carcinoma of the chin is reported. Intraoral radiographic examination revealed in the lower left mandible a poorly defined area of increased radiolucency extending from the mesial of the cuspid to the mesial of the second molar. A dense area between the first cuspid and second molar corresponding with the exposed necrotic bone was also seen. Palliative treatment involved careful cleaning and rinsing of the denuded bone and application of a dressing of coe-pak covering the entire area from the lateral to the molar. (E.R.B.)

36387 RADIATION HAZARD CONTROL IN DENTAL PRACTICE. Schmidt, Arthur. J. Ont. Dent. Ass.; 48: No. 6, 194-6(Jun 1971).

During 1970, a survey was made of x-ray machines used for radiography by dental surgeons in Ontario, Canada. In 95% of the installations surveyed, some inadequacy in physical or procedural controls or deficiency in the x-ray equipment was noted. Only 5% of the installations surveyed appeared to meet the requirements of Ontario Regulation 29/69 regarding x-ray safety. It was concluded that the level of general compliance and hazard control in the dental owner group surveyed was lower than in hospitals and industrial establishments. (E.R.B.)

36388 PROTECTION OF THE TEETH AND JAWS IN SHORT-FOCUS X RAY TREATMENT OF TUMORS OF THE LIPS. Akatkin, O. A.; Pinskii, I. Kh. (Kuban State Medical Inst., Krasnodar, USSR). Med. Radiol.; 17: No. 2, 53-6(Feb 1972). (In Russian).

Basing upon dosimetric and spectrometric measurements, materials were selected for the preparation of screens used for the protection of the teeth and jaws during short-focus x-ray therapy. Multistratal screens, the internal layers of which are made from metal-containing materials and external layers from elastomers, ensure protection of bone tissues from the effect of the primary beam of radiation simultaneously with reduction of radiation loadings on the mucous membrane from secondary, scattered, and characteristic radiation. The optimal thickness of the external layer of the screen and the designs of screens are described. (auth)

36389 INSURANCE CONSIDERATIONS FOR MEDICAL RADIOLOGISTS. Di Paolo, R.; Caiazzo, V. (Univ., Naples). Folia Med. (Naples); 53: No. 2-3, 41-50(Feb-Mar 1970). (In Italian).

A list of 29 cases of lesions caused by exposure to ionizing radiations observed in physicians in the Campania and Molise Provinces during the period 1959 to 1968 is presented. The highest percentage concerns radiologists and radiodermatitis was the lesion most prevalent. The hematic alterations associated with radiodermatitis occupied the 2nd place for frequency, while the cases of leukemia and tumors, in the absence of radiodermatitis reached a frequency of 6.8%. (auth)

36390 RADIATION MYELITIS ASSOCIATED WITH GAMMA THERAPY OF CANCER OF THE ESOPHAGUS AND LUNGS. Khairushev, Zh. A.; Perzadaev, A. N.; Balmukhanov, S. B.; Abdrakhmanov, Zh. N. (Kazakh Scientific-Research Inst. of Oncology and Radiology, USSR). Med. Radiol.; 17: No. 2, 33-41(Feb 1972). (In Russian).

Nine patients with cancer of the esophagus and lungs who after radiation treatment developed myelitis were observed. An analysis of personal observations and pertinent literature data enabled to arrive at the inference that complications of the spinal cord occur usually in total doses of 1000 rad and commonly at periods of 3 to 15 months after the beginning of irradiation. The terms of development of complications depend on the value of fractionation of the dose. Early radiation myelopathia appears during irradiation or during the first two months thereafter and are manifested by segmental vegetative-trophic and sensory disorders. Late radiation myelitis develops 0.5 to 2½ years later and terminate by a picture of transverse lesion of the spinal cord. (auth)

36391 CLINICO-ROENTGENOLOGICAL STUDIES IN POSTOPERATIVE RADIATION THERAPY OF LUNG CANCER. Savitskaya, A. A.; Magazanik, R. L. (Scientific-Research Roentgeno-Radiological Inst., Moscow). Med. Radiol.; 17: No. 2, 28-33(Feb 1972). (In Russian).

The paper analyzes the clinico-roentgenological changes occurring in thoracic organs in patients with cancer of the lung after surgical and subsequent radiation treatment. The importance of the roentgenological method of investigation in the dynamic observation of patients and in the detection of metastases and relapses against the background of postoperative changes in the lungs and mediastinum is emphasized. The relation between radiation induced changes in the pulmonary tissue and the focal dose and value of the daily dose and duration of irradiation of the patient is stressed. (auth)

36392 CHANGES OF ILIAC LYMPHATIC PLEXI DURING TELEGAMMA THERAPY. Zedgenidze, G. A.; Tsyb, A. F.; Mardynskii, Yu. S.; Nestaiko, O. V.; Khananashvili, Ya. A. (Scientific-Research Inst. of Medical Radiology, Moscow). Med. Radiol.; 17: No. 2, 3-9(Feb 1972). (In Russian).

The roentgenolymphograms of the first and repeated investigations of iliac lymphatic plexi with no metastatic affection were studied in 29 patients suffering from cancer of the urinary bladder. A repeated low lymphography was carried out 2 to 18 months after telegammatherapy. The single and total doses of irradiation of iliac lymphatic links were determined individually for each patient. Lymphographic changes in vessels and nodes occur in irradiation with doses not less than 2500 rad and augment with increase of the irradiation. These alterations were manifested by narrowing of the lumen and loss of the characteristic pattern of lymphatic collectors, in reduction of the size, and densening of the structure of the lymph nodes. The markedness of radiation changes depends upon the time that passed after irradiation. (auth)

36393 BREAST CARCINOMA 30 YEARS AFTER THOROTRAST MAMMOGRAPHY. Ahmed, M. Y. (Kingston General Hospital, Ont. Queen's Univ., Kingston, Ont.); Steele, H. D. Can. J. Surg.; 15: 45-9(Jan 1972).

A 60-year-old woman, who had bilateral mammography with Thorotrast 30 years before, was found to have an adenocarcinoma of one breast in 1969. The other breast was subsequently removed and was found to contain Thorotrast and fibrosis but no tumor. The potential radiation danger of thorium dioxide may be small but, when retained at one site over a long period, can and has produced carcinomas and sarcomas of various tissues. Thorotrast was popular as a radiologic diagnostic agent between 1930 and 1950, then its use declined. Today there is an unknown number of people who must have it in their tissues, have the potential to develop a malignancy, and who should be watched accordingly. (auth)

36394 PIONS AND HEAVY IONS IN RADIOTHERAPY. Bewley, D. K. (Hammersmith Hospital, London). Nature (London); 237: No. 5349, 17-19(5 May 1972).

The advantages and difficulties of using pions and heavy ions for cancer radiotherapy are discussed, following an historical survey of the subject. With regard to dose distribution the use of heavier charged particles seems favorable since they travel almost in straight lines, producing beams with sharp edges, and give an enhanced dose near the end of their range (the Bragg peak) with zero dose beyond. A depth-dose distribution curve is shown for 4 GeV N^{7+} ions and for 60 MeV π-mesons (negative pions). The pions are captured by nuclei, usually 0 in the case of soft tissue, after being brought to rest, and the resulting nuclear reactions produce several charged particles and neutrons, the former causing an increment of dose in the tumour volume. Some of the π^--pions decay in flight giving μ^--mesons which, together with contaminating electrons, contribute to the dose. A brief account is given of the radiobiological properties of tumour cells as compared with normal cells, including LET and RBE considerations, and it is concluded that the radiobiological properties of beams of heavy ions will remain uncertain until experimental observations are available. Some experimental work on the use of protons, α particles, and heavy ions for the radiotherapy of cancer is described; also π^--mesons. It is pointed out, however, that any attempt to use heavy ions or negative pions for radiotherapy will be very expensive, and suitable machines are discussed; also that no dramatic increase in the overall rate of curing cancer can be expected from these new forms of treatment. The presence of hypoxic cells in many tumours is the only reason for which high LET irradiation is likely to be advantageous, and even this may prove an illusion. The distribution with depth of biologically effective dose, however, is so much closer to the ideal, compared with x rays or electrons that improved therapeutic results must accrue, particularly for deep seated cancers. (UK)

36395 FILTER INTERLOCKS ON GRENZ-RAY UNITS, A POTENTIAL HAZARD. Peake, J. C. F. (St. Luke's Hospital Guildford, Eng.). Brit. J. Radiol.; 45: No. 533, 391(May 1972).

A near failure of a filter interlock circuit is described, in connection with a Grenz-ray unit operating at 10 to 50 kV in 10 kV steps. Perished rubber insulation was found on a lead running from the control console to the microswitch, which had to be closed by insertion of a filter at the end of the tube, before x rays could be generated. The unit could be operated with no filtration in the beam, either when the two bare wires shorted together, or if the microswitch in the tube head failed in the closed position. At 50 kV with an unfiltered beam, the measured exposure rate was 4,250 R/min at 30 cm FSD and the estimated rate at the end of the shorter 10 cm FSD applicators was 40,000 R/min. These measurements indicated an output 50 times the normal level. The hazards are briefly discussed, with particular reference to superficial single fraction x ray treatments. (UK)

36396 NEUTRON: MEASUREMENTS RELEVANT TO ITS THERAPEUTIC USE. Martin, J. H. (Univ. of Dundee, Scotland). Australas. Bull. Med. Phys. Biophys.; No. 53, 4-27 (1 Apr 1972).

A summary is made of the developments in neutron therapy with particular reference to measurement of biological effectiveness. Although the importance of spatial distribution of energy deposition events and their size has been demonstrated, difficulties are still encountered in considering energy depositions in regions of molecular dimensions within a cell. It is thought that the general picture will be clarified by more knowledge of stages in lesion production and development. Some experiments with this end in mind are described. Comparison is made with other radiotherapeutic irradiations and attention is drawn to the role of neutrons in irradiation of anoxic tumor cells. (Australia)

36397 RADIATION DOSIMETRY IN DIAGNOSTIC PROCEDURES. Emery, E. W.; Fowler, J. F. (Hammersmith Hospital, London). pp 171-87 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

The uncertainties in radiation dosimetry in radioisotope clinical procedures are reviewed. It is pointed out that the activity assigned to a particular batch of radioactive material may be in error by 5% or more and uncertainties regarding the gross distribution and metabolic behavior of administered radioactive substances add to the difficulties of estimating the radiation dose. The need for radiation dose calculations in weighing the need for a particular diagnostic test against the radiation hazard to the patient is stressed. Methods used for the estimation of the total radiation dose absorbed, the β dose, and the γ dose are described. Tabulated data are included on the mass of standard man and various organs, the average β-ray and γ-ray energies per disintegration for some 40 radioisotopes commonly used as tracers, and the average total absorbed dose rates (β plus γ) from 1 μCi/kg of these radioisotopes when uniformly distributed. The relation of the biological and radioactive half-life of the radioisotope to the radiation dose absorbed is discussed. (C.H.)

36398 RADIATION HAZARDS IN WORK WITH RADIOISOTOPES. Vennart, J. (Dept. of Health and Social Security, Surrey, Eng. Medical Research Council, Surrey, Eng.). pp 188-217 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

The radiation hazards to human patients, medical personnel, and the general population that may develop when radioisotopes are used for clinical diagnostic tests are reviewed. Criteria for the control or reduction of radiation hazards are presented. (C.H.)

36399 RADIATION PROTECTION OF CHILDREN. Schuster, W. (Univ., Erlangen, Ger.). Hefte Unfallheilk.; 102: 173-8 (1970). (In German).

Procedures for x-ray diagnosis in children are outlined. The examination should be performed only with modern high-power equipment with shortest possible exposure time (maximal 10 msec.). The x-ray tube should have a double focus and an inherent filtration of at least 3 mm Al. The immobilization of infants and small children by plastic covers; automatic triggering of the x-ray tube during inspiration and expiration; automatic setting of exposure times; image intensifiers with 70 mm photographic camera, and electronic contrast enhancement are discussed. (H.B.G.)

Vertebrates

Refer also to abstracts 35798, 36462, and 36470.

36400 (AEC-tr-7304) RADIOBIOLOGY. Translation of Radiobiologiya; 11: No. 4, 483-640(1971). 212p. Dep. NTIS.

Separate abstracts were prepared for the 35 papers appearing in this cover-to-cover translation. (E.R.B.)

For abstracts of individual papers see: 36322, 36323, 36333, 36340, 36354–36359, 36375, 36401–36421, 36452, 36458, and 36459.

36401 (AEC-tr-7304, pp 1-15) QUANTITATIVE ASPECTS OF MODERN RADIATION IMMUNOLOGY AND THE PROBLEM OF THE EFFECT OF RADIATION ON INTERCELLULAR COOPERATIVE PROCESSES. Petrov, R. V.; Koval'chuk, L. V.; Cheredeev, A. N. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 483-94(1971).

The results of purposeful investigations of the dynamics of cells of the lymphoid system with a quantitative evaluation of the number and functional activity of the lymphocytes, immunocompetent precursors, hematogenic stem cells, and antibody-producing cells for a period of 2 months after sublethal irradiation of CBA and (CBAxC57 BL)F_1 mice conducted in the laboratory for a number of years, are generalized. The results obtained are discussed from the standpoint of radiation disruption of the normal intercellular cooperative processes, essential for the realization of one immunological effect or another. The prospects of the new problem of quantitative radiation immunology, that is, the effects of radiation on the interaction of various cellular types, participating in the immune response, which has arisen in our day, are substantiated. (tr-auth)

36402 (AEC-tr-7304, pp 16-20) INDUCIBLE ENZYMES AND IONIZING RADIATION. COMMUNICATION III. CHANGE IN THE TYROSINE-ALPHA-KETOGLUTARATE-AMINOTRANSFERASE ACTIVITY IN THE RAT LIVER UNDER THE INFLUENCE OF CERTAIN RADIOPROTECTIVE AGENTS (ONE TEST OF ACCELERATED DETERMINATION OF RADIOPROTECTIVE ACTION). Popov, P. G.; Belokonskii, I. St. (Higher Military-Medical Inst., Sofia). Translated from Radiobiologiya; 11: No. 4, 495-8(1971).

The change in the activity of tyrosine-alpha-ketoglutarate-aminotransferase (TAKAT) was followed after the use of radioprotectors (RP): cysteamine, cystamine, AET, serotonin, and 5-methoxytryptamine. It was established that in nonirradiated animals RP caused an increase in the TAKAT activity by the fourth hour after injection. By 72 hrs after injection of RP, in nonirradiated rats a normal or slightly reduced enzyme activity is observed. When RP from the aminothiol group are introduced at definite periods before irradiation at a dose of 900 R, a decrease of from 1.9- to 2.3-fold in the TAKAT activity, elevated by the 72d hr after irradiation, is noted, while at a dose of 600 R complete normalization of the enzyme activity is observed. The lowering of the TAKAT activity by radioprotectors by the 72d hr after irradiation approximately corresponds to the dose change factor for the same RP, determined according to death rate. (tr-auth)

36403 (AEC-tr-7304, pp 21-7) PHYSICOCHEMICAL PROPERTIES OF HEMOGLOBIN OF DOGS IN THE NORMAL STATE AND AFTER IRRADIATION. Olontseva, O. I. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 499-503(1971).

It was established by the methods of column chromatography on CM-cellulose, electrophoresis on paper, and alkaline denaturation of hemoglobin according to Singer that the hemoglobin of dogs is heterogeneous. The basic component HbA constitutes 94%, while the two minor components M_1 and M_2 come to 1.5 and 4.5%, respectively. Hemoglobin A sometimes has the minor component A_1. When dogs are irradiated, changes are detected in the fractional composition of hemoglobin: a 20 to 30% increase in the minor component A_1 with a simultaneous decrease in HbA and an increase in the relative content of alkali-stable hemoglobin of the fraction M_1. All these changes disappear in animals in the long-term periods after irradiation. (tr-auth)

36404 (AEC-tr-7304, pp 28-34) DEPENDENCE OF THE THERAPEUTIC EFFECT ON THE METHOD OF INTRODUCTION OF DNA IN ACUTE RADIATION SICKNESS. Kirillova, E. N. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 504-9(1971).

It was shown that the therapeutic effect of high-polymer homologous DNA in the treatment of rats irradiated at a dose of 655 R

($LD_{50/30}$) depends on the method of introduction of the preparation. The largest percentage of surviving animals is noted in the case of subcutaneous and intramuscular injection of the biopolymer. In DNA-treated rats, in comparison with the untreated control, less pronounced clinical symptoms of acute radiation sickness were observed. (tr-auth)

36405 (AEC-tr-7304, pp 35-43) INFLUENCE OF EXOGENOUS DNA ON THROMBOPOIESIS OF IRRADIATED ANIMALS. Babushkina, A. G. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 510-16(1971).

Exogenous DNA, administered to rats one day after irradiation at a dose of 655 R ($LD_{50/30}$), reduced the disruption of thrombopoiesis. The best effect was obtained when homologous DNA was used, in comparison with heterologous DNA. Treatment of the animals with DNA preparations at the absolutely lethal dose (950 R) had no influence on the megakaryocyte-thrombocyte system. (tr-auth)

36406 (AEC-tr-7304, pp 44-50) COMPARATIVE ELIMINATION OF THE RADIOPROTECTIVE AND TOXIC EFFECTS OF CYSTAMINE. Vasin, M. V.; Davydov, B. I.; Antipov, V. V. Translated from Radiobiologiya; 11: No. 4, 517-21(1971).

A comparative evaluation of the elimination of the radioprotective and toxic effects of cystamine was conducted in experiments on mice. T_{50} of cystamine with respect to radioprotective and toxic properties in nonirradiated and irradiated animals was 0.8, 1.8, and 2.3 hrs, respectively. If the protective properties of cystamine during the first hour after its application depend on the concentration of the substance in the radiosensitive organs, then during the subsequent period (from 1 to 5 hrs) the radioprotective action of the protector is not so closely associated with the level of cystamine content and that of its metabolites in the tissues of the organism. The most clearly mediated action of cystamine is manifested in the nature of the elimination of the toxic properties of the protector. (tr-auth)

36407 (AEC-tr-7304, pp 51-8) MECHANISM OF THE BIOLOGICAL ACTION AND RADIOPROTECTIVE EFFECT OF DIMETHYL SULFOXIDE. Grozdov, S. P.; Bezin, G. I.; Kendysh, I. N.; Kir'yanov, I. Yu.; Vasil'evskaya, V. V. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 522-7(1971).

Dimethyl sulfoxide (DMSO) induced a pronounced radioprotective effect in rats, which increased substantially when it was combined with the administration of ATP. DMSO also reduces the effect of corticosteroids on tissues, although it enhances their secretion in the organism. The reduction of the oxygen consumption, inhibition of glycolysis, and other indices are evidence of an inhibition of metabolic processes in the lymphoid tissues under the action of DMSO. In contrast to other radioprotectors, DMSO does not cause hypoxia, an increase in the content of SH groups, or a decrease in the redox potential in the tissues. The differences in the mechanism of the action may be explained by the additive effects of DMSO with other radioprotectors. (tr-auth)

36408 (AEC-tr-7304, pp 66-70) RADIOPROTECTIVE ACTIVITY OF DIAMMONIUM AMIDOTHIOPHOSPHATE. Tikhomirova, M. V.; Yakovlev, V. G.; Klimova, R. A. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 533-6(1971).

A pronounced prophylactic effect of diammonium amidothiophosphate (DATP) in the case of brief irradiation at a high dose rate was established in experiments on mice and rats. In acute radiation sickness in dogs, the radioprotective action of DATP is manifested only when it is administered in toxic doses. The preparation promotes a smaller initial damage to the hematogenic tissue and substantially accelerates the repair of hemopoiesis. (tr-auth)

36409 (AEC-tr-7304, pp 75-80) COMPARATIVE STUDY OF THE DYNAMICS OF THE INDICES OF NONSPECIFIC IMMUNITY UNDER THE ACTION OF LONG-WAVE AND SHORT-WAVE X RADIATIONS. Shubik, V. M.; Kolotvin, V. A.; Livshits, R. E.; Bronshtein, I. E. (Scientific Research Inst. of Radiation Hygiene, Leningrad). Translated from Radiobiologiya; 11: No. 4, 540-4(1971).

The results of a comparative dynamic study of a complex of immunological reactions, characterizing the state of nonspecific immunity (bactericidal properties, lysozyme titer, and complement of blood serum) as well as tests for general immunological reactivity following a single total irradiation of white rats with long-wave and short-wave x rays are presented. Significant differences were found in the changes in the immunological indices under the action of the same exposure doses of long-wave and short-wave x radiation. The differences noted are associated with the different penetrating ability of x rays with effective energy 14 and 75 keV, as a result of which the absorbed doses in the tissues differ. (tr-auth)

36410 (AEC-tr-7304, pp 81-7) EFFECTS OF RADIATION ON TRANSPLANTATION IMMUNITY: REMOVAL OF INACTIVATION OF NONSYNGENIC STEM CELLS BY LYMPHOCYTES. Man'ko, V. M. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 545-9(1971).

It was shown that the function of inactivation of nonsyngeneic stem cells by lymphocytes is substantially more radioresistant than the proliferative activity of the hemopoietic or lymphoid elements; D_0 for radiation inactivation of the ability of the lymphocytes to inhibit the multiplication of nonsyngeneic CFU is 535 R, n = 1.08; D for reproducing hematogenic or antibody-producing cells is 70 to 125 R, n = 1.0 to 2.72. With increasing dose of irradiation of the lymphocytes, the size of the growing (noninactivated) colonies of hematogenic cells increases. The inactivation of nonsyngeneic stem cells necessitates functional activity of allogeneic lymphocytes; however, their reproduction is not a necessary condition in the realization of the effect of inactivation. (tr-auth)

36411 (AEC-tr-7304, pp 88-94) PECULIARITIES OF THE COURSE OF THE INTESTINAL PHASE OF RADIATION SICKNESS IN GUINEA PIGS. Altukhova, L. N. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Translated from Radiobiologiya; 11: No. 4, 550-4(1971).

The course of the intestinal phase of radiation sickness, the periods of death, and the degree of damage to the small intestines of guinea pigs were investigated after irradiation of various portions of the organism. It was established that the development of the intestinal syndrome is associated with the direct influence of radiation on the region of the abdomen. In guinea pigs, in contrast to mice and rats, the intestinal phase of radiation sickness proceeded in a weakened form, developed from higher doses of radiation (above $LD_{100/30}$), and was manifested in late periods (5 to 7 days). (tr-auth)

36412 (AEC-tr-7304, pp 95-101) STATE OF SPERMATOGENESIS UNDER CONDITIONS OF CHRONIC IRRADIATION OF MONKEYS. Fedorov, B. A.; Dzhikidze, E. K. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Translated from Radiobiologiya; 11: No. 4, 555-9(1971).

The state of the testes of sexually mature monkeys during chronic gamma irradiation (single doses 1.17 to 4.6 R, summary doses from 512 to 3677 R) was studied. It was shown that the degree of disturbance of spermatogenesis depends on the single and summary doses of radiation. The summary dose of radiation at which a partial restoration of spermatogenesis arose (one year 5 to 7 months after the cessation of irradiation) was 1451 R (single dose 1.17 R) and 1044 R (single dose 4.6 R). Increasing the summary dose of 1500 to 3600 R, regardless of the single dose, led to absolute sterility of the males for a period of 9 years 9 months after the cessation of irradiation. (tr-auth)

36413 (AEC-tr-7304, pp 102-9) MORPHOLOGICAL CHANGES AND DISRUPTIONS OF PHYSIOLOGICAL FUNCTIONS OF THE ORGAN OF EQUILIBRIUM OF THE RABBIT AFTER THE INFLUENCE OF IONIZING RADIATION. Shikhodyrov, V. V.; Arlashchenko, N. I.; Grigor'ev, Yu. G. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 560-5(1971).

The most pronounced physiological disorders of the labyrinth function are noted during the first hours after the influence of gamma radiation at a dose of 800 R. During this period, disorders of the lymphodynamics of the organ arise that lead to compression of the membranous labyrinth. The morphological changes in the labyrinth during later periods after irradiation are evidence of dystrophic disturbances of its structure. (tr-auth)

36414 (AEC-tr-7304, pp 154-8) INFLUENCE OF IRRADIATION ON THE ACTIVITY OF DEOXYCYTIDYLIC ACID DEAMINASE OF RABBIT BONE MARROW. Elkina, N. I.; Libinzon, R. E. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 598-601(1971).

The activity of deoxycytidylic acid (d-CMP) deaminase in the bone marrow of rabbits irradiated at doses of 500 and 1000 R was investigated. A decrease in the activity of the enzyme, calculated per mg protein and per g of tissue, was detected beginning with 16 hrs after irradiation at a dose of 1000 R and 24 hrs at a dose of 500 R. Three days after the influence of 500 R and 3 and 6 days after 1000 R, the activity of d-CMP deaminase was not detected at all. Six days after irradiation at a dose of 500 R and 9 days after 1000 R, some restoration of the activity of this enzyme was observed. (tr-auth)

36415 (AEC-tr-7304, pp 162-6) INFLUENCE OF BLOODLETTING ON RNA SYNTHESIS IN THE BONE MARROW OF IRRADIATED RABBITS. Pavlov, A. D.; Morshchakova, E. F. (Sverdlovsk State Medical Inst., USSR). Translated from Radiobiologiya; 11: No. 4, 604-7(1971).

Whole-body x irradiation of rabbits at a dose of 714 R inhibits the incorporation of ^{32}P into the total high-polymer RNA of the bone marrow 18 to 20 hrs after the influence. Bloodletting, performed 1 hr before irradiation in a volume of 2% of the body weight, substantially stimulates the incorporation of ^{32}P into RNA. A stimulating effect of bloodletting on RNA synthesis in the bone marrow was also expressed on the seventh to ninth day after irradiation in a stage of pronounced anemia. The increase in the RNA synthesis in the bone marrow of irradiated rabbits after preliminary bloodletting is probably associated with an increased manufacture of erythropoietin. (tr-auth)

36416 (AEC-tr-7304, pp 167-71) INFLUENCE OF EXTERNAL WHOLE-BODY BETA IRRADIATION ON THE COMPOSITION OF THE PERIPHERAL BLOOD OF RATS. Smirnov, A. V.; Petrovich, I. K. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 607-10(1971).

The changes in the morphological composition of the peripheral blood of rats (males and females), subjected to whole-body external beta irradiation on an apparatus with sources of strontium-90 + yttrium-90, in a broad range of doses (800 to 4500 rad), were investigated. Data were obtained on substantial changes in the composition of the peripheral blood of the rats. Substantial differences were detected in the response of the blood of rats of different sexes. In addition, a relationship was discovered between the dose and the composition of the peripheral blood of the rats. (tr-auth)

36417 (AEC-tr-7304, pp 172-5) QUANTITATIVE COMPARISON OF THE FREQUENCY OF DEVELOPMENT OF GASTROINTESTINAL DISORDERS WITH THE VALUES OF THE DOSES ABSORBED IN THE REGION OF THE INTESTINE BY RATS IN VARIOUS VARIATIONS OF NONUNIFORM WHOLE-BODY GAMMA AND X RAY INFLUENCES. Avetisov, G. M. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 610-13(1971).

In an experiment on 1,250 noninbred male rats subjected to whole-body irradiation in various nonuniform fields of gamma and x radiation, it was shown that the frequency of development of diarrhea does not depend on the method of nonuniform influence, but is determined by the dose absorbed in the region of the abdomen. The index of lesion of the gastrointestinal tract under consideration exhibits a threshold. At doses less than 450 rad in the region of the abdomen, diarrhea did not develop among the rats, regardless of the mode of influence. The dependence of the frequency of appearance of diarrhea on the dose absorbed in the region of the abdomen is S-shaped. A mathematical analysis of the indicated dependence is cited, with a comparison with other indices of radiation damage: maximum loss of weight of dried small intestine and values of the dose causing 50% lethality of rats ($LD_{50/30}$). (tr-auth)

36418 (AEC-tr-7304, pp 176-9) RELATIONSHIP OF THE RADIOSENSITIVITY OF ANIMALS TO THE GEOMAGNETIC FIELD. Dubrov, A. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Translated from Radiobiologiya; 11: No. 4, 613-16(1971).

The author had previously advanced a hypothesis and cited experimental and analytical evidence that the permeability of the biological membranes, as well as physiological and genetic homeostasis, are under the control of the geomagnetic field. This article cites examples indicating that fluctuations of radiosensitivity are also associated with a change in the geomagnetic field. (tr-auth)

36419 (AEC-tr-7304, pp 180-2) DETECTION OF AUTOHEMOLYSIN-PRODUCING CELLS IN THE BLOOD OF IRRADIATED AND IMMUNIZED ANIMALS BY THE MODIFIED JERNE METHOD. Ter-Pogosyan, R. A.; Kamalyan, L. A.; Koshkakaryan, K. Kh.; Malikoyan, S. A. (Ministry of Health Armenian SSR, Erevan). Translated from Radiobiologiya; 11: No. 4, 616-18(1971).

The autoimmune process in irradiated and immunized rabbits was studied by means of the Jerne method, modified by N. N. Klemparskaya, permitting the dynamic detection of autohemolysin-producing cells in the blood. The level of plaque-forming cells in rabbits after immunization increases at earlier periods (from the third day on) than after irradiation (from the 14th day). In rabbits irradiated after immunization, more rapid normalization of the level of plaque-forming cells is noted. (tr-auth)

36420 (AEC-tr-7304, pp 183-6) CYTOGENETIC DAMAGES IN CELLS OF THE REGENERATING RAT LIVER AFTER TOTAL IRRADIATION WITH X RAYS AN HIGH-ENERGY PROTONS. Mikhaylova, N. Ya.; Komar, V. E. (Central Scientific Research Roentgenoradiological Inst., Leningrad). Translated from Radiobiologiya; 11: No. 4, 618-21(1971).

The frequency of cells with chromosome rearrangements in the regenerating rat liver was investigated after irradiation with X rays and 645 MeV protons in the G_1 (5 to 5.5 hrs) and S (23 to 24 hrs) periods of the cellular cycle. It was shown that after x irradiation the sensitivity of the G_1 period with respect to the frequency of aberrant cells is higher than in the S period. In the case of proton irradiation, no such differences were observed. The relative biological effectiveness (RBE) of protons for the G_1 period is equal to one, for the S period 1.6, followed by a decrease to one. (tr-auth)

36421 (AEC-tr-7304, pp 187-90) EFFECTIVENESS OF SEROTONIN, MEXAMINE, AET, AND CYSTAMINE IN THE CASE OF REPEATED ADMINISTRATION AFTER GAMMA IRRADIATION. Shashkov, V. S.; Anashkin, O. D.; Suvorov, N. N.; Manaeva, I. A. Translated from Radiobiologiya; 11: No. 4, 621-3(1971).

The effectiveness of serotonin, mexamine, AET, and cystamine was studied in experiments on rats with repeated administration during the first hr after whole-body gamma irradiation at a dose of 800 R. Four administrations of serotonin in doses of 2.3 and 3 mg/kg increased the survival of the rats by 40 and 30%, respectively; the introduction of mexamine at a dose of 4 mg/kg produced a 13.5% increase in survival; the introduction of cystamine at a dose of 3.33 mg/kg, 26%; and the use of AET in doses of 5 and 2 mg/kg 13.5 and 34%, respectively, in comparison with the control animals. (tr-auth)

36422 (CONF-720505-1) RADIATION-INDUCED IMMUNOSUPPRESSION: DEMONSTRATION OF ITS ROLE IN RADIATION LEUKEMOGENESIS IN THE INTACT RF MOUSE. Yuhas, John M.; Tennant, R. W.; Hanna, M. G. Jr.; Clapp, N. K. (Oak Ridge National Lab., Tenn.). [1971]. Contract W-7405-eng-26. 24p. Dep. NTIS.

From twelfth Hanford biology symposium on radionuclide carcinogenesis; Richland, WA. (11 May 1972).

Through an analysis of the immunologic and virologic nature of glomerulosclerosis in the RF mouse, it has been established that this disease results, at least in part, from an immune response to vertically transmitted wild type Gross leukemia virus (MuLV) antigens. The complexes of antigen and antibody lodge in the glomeruli, giving rise to glomerulosclerosis. Analysis of the leukemia patterns in these glomerulosclerotic mice has demonstrated that the immune response which this disease reflects reduces the probability of leukemia by a factor of 2. Further, radiation doses in excess of 100 rads suppress the development of this immune response, and this suppression contributes to the increased leukemia risk in this dose range. (auth)

36423 (COO-3013-4) TUMOR CELL POPULATION KINETICS DURING RADIATION LYMPHOMOGENESIS. Fabrikant, Jacob I. (Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences). [nd]. Contract AT(30-1)-3970. 5p. (CONF-691233-2). Dep. NTIS.

From fifty-fifth annual meeting of the Radiological Society of North America, Chicago, IL. (1 Dec 1969).

The kinetics of cellular proliferation in the thymus of young C57BL mice were examined during x radiation lymphomogenesis. Initially, there was cellular depopulation followed by regeneration to normal cell levels by about 11 weeks. In a large proportion of the thymuses, there was cortical hypertrophy and increased cellularity, and lymphoma developed by 11 to 14 weeks. Thymidine labeling indices increased during this period, particularly in the medium and small lymphoid cell compartments, to twice-normal levels by 13 weeks, at the time of thymic lymphoma, and to four-fold values by 25 weeks, at the time of disseminated lymphoma. This was associated with an increased duration of DNA synthesis and of the median cell cycle time in successive generations. The proliferative fraction progressively increased and this may have been due to a greater proportion of cells proliferating in the medium and small lymphocyte compartments, and possibly to bringing into proliferation nondividing cells which still have proliferative potential. On the basis of the changes observed in the thymus cell population structure and proliferative characteristics during and after irradiation, it is probable that factors which contribute to the production of lymphoma involve a progressive deterioration of normal control mechanisms concerned with the regulation of cell reproduction and differentiation. This may involve a steady dedifferentiation of the basically nonproliferating small lymphocyte into a more primitive proliferative form associated with the loss of capacity to differentiate among the more primitive precursor lymphoid cells. (auth)

36424 (COO-3013-20) KINETICS OF CELLULAR PROLIFERATION IN THE SEMINIFEROUS EPITHELIUM UNDER CONTINUOUS IRRADIATION AT 45 RADS PER DAY. Hsu, Thomas H. S. (Johns Hopkins Univ., Baltimore, Md. School of Hygiene and Public Health). Sep 1971. 43p. Dep. NTIS. Thesis.

Cellular response and cell population kinetics in the premeiotic stages of spermatogenesis in the seminiferous epithelium of the C57BL/6J black mouse under continuous irradiation were examined using the techniques of quantitative histology and high resolution autoradiography combined with specific labeling of DNA with ^{3}H-thymidine. In the unirradiated seminiferous epithelium, four divisions of the type A spermatogonia, and one each of intermediate and type B cells comprise one cycle of spermatogonial cell renewal which takes approximately 8.5 days. The rapid rate of cell proliferation in the spermatogonial population balances cell loss through differentiation and maturation of the spermatocytes into spermatozoa during spermiogenesis, thereby maintaining a steady state of cell renewal so that the duration of the seminiferous epithelium is about 34 days. Continuous irradiation at 45 rads per day resulted in a rapid depletion of the type B and intermediate cells; however, resting primary spermatocytes continued normally into spermatids which eventually differentiated into spermatozoa. The type A spermatogonia could maintain a near-steady state of cell proliferation with very little change in thymidine labeling and mitotic indices, indicating very little change in its cell kinetic parameters, but at a population level of about 55% of control values. After continuous irradiation for two weeks, cellular recovery during a radiation-free interval occurred with rapid repopulation of the seminiferous epithelium. Restitution first occurred in the intermediate cell compartment, followed by repopulation of the type B cells. Subsequently, the type A spermatogonial population returned to normal levels. Initial waves of spermatogenesis during recovery indicated a speeding-up of the cell cycle; however, at the end of 13 weeks in the recovery period, normal cell cycle times and characteristics were restored. The experimental results of the investigation are discussed in terms of factors affecting homeostasis in irradiated tissues, primary cellular radiosensitivity and compensatory cell proliferation. (auth)

36425 (EUR-4759) STUDY OF EARLY RADIATION LESIONS AND THEIR DETECTION (ALARM REACTIONS). Annual Report, 1970. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1972. 30p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 50,-.

Research on the metabolism of desoxycytidine, the synthesis of nuclear proteins, the catabolism of denatured proteins and the metabolism of the coenzymes of nicotinamide and tryptophane was carried out. Studies of the cytological indicators were made on both small mammals and man. Examination in vitro of the leukocytes of persons exposed to ionizing radiations in the exercise of their profession revealed a relationship between the rate of anomalies observed and the time spent in that profession. Research was also carried out on the cellular permeability of ascitic tumor cells in DNA. The radiosensitivity of mitochondrial DNA after injection of hydroxyurea was studied. An intense reutilization of marked metabolites was observed during the synthesis of nuclear DNA after partial hepatectomy. It was more intense for tritiated thymidine than for iododesoxyuridine. Studies on the influence of radioprotectors on the retarded effects of radiations showed that 2-B-aminoethylisothuria-Br-HBr (AET) shortens the life span of nonirradiated Wistar rats and is toxic for the kidneys. The dose reduction factor given by AET for the average survival of male BALB/c mice is 1.5. An association of 5 radioprotective substances, depending on the radiation dose in question, gave a dose reduction factor varying from 1.5 to 3. This association also strongly influenced the rate of leukemias (lymphoid or myeloid) induced by the radiations and shortened the period of temporary sterility in male mice exposed to irradiation. Modification of the ultrastructure of mouse lungs after exposure to supralethal doses of ionizing radiations was also studied. (auth)

36426 (JPRS-55687) SPACE BIOLOGY AND MEDICINE. Translation of Kosm. Biol. Med.; 6: No. 1, 3-93(1972). 146p. NTIS.

This report contains articles concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the "man-spaceship" system; space psychology and physiology; environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) and telemetry. A separate abstract was prepared on one paper. (TSS)

For abstract of individual paper see: 36427.

36427 (JPRS-55687, pp 1-6) RADIOBIOLOGICAL EFFECTS AFTER 3-YEAR GAMMA IRRADIATION OF DOGS. Grigor'ev, Yu. G.; Markelov, B. A.; Popov, V. I.; Akhunov, A. A.; Ilyukhin, A. V.; Tsessarskaya, T. P.; Sedov, A. V.; Korsakov, V. A. Translated from Kosm. Biol. Med.; 6: No. 1, 3-7(1972).

Results are summarized from a three-year radiobiological experiment on dogs. In several experimental series chronic γ irradiation with varied dose rates (21 to 150 rad per year) and chronic irradiation combined with acute exposures (total doses of 190 rad per year) were applied. Clinical hematological, physiological, and cytological examinations demonstrated that the animals maintained a satisfactory clinical condition and exhibited no serious organic radiation damage. However, a decrease in their compensatory potentialities and a change in their reactivity were noted. (auth)

36428 EFFECTS OF IRRADIATION OR TRAUMATIC INJURIES ON PROPIONATE METABOLISM IN RATS. Henderson, Thomas R.; Jones, Robert K. (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Clin. Chem.; 17: No. 8, 810-17(Aug 1971).

From third annual symposium on high-resolution analyses and advanced concepts for the clinical laboratory; Oak Ridge, Tenn. (11 Mar 1971).

The rate of $^{14}CO_2$ production in vivo by rats after injection with 10 μCi of 1-^{14}C-propionate is useful in selecting uniform groups of animals for studies of experimental injuries and in investigating dose-response relationships in animals exposed to injury. The response appeared to be most sensitive to lung injury induced by air-blast, but was also sensitive to critical levels of irradiation or thermal exposure. Irradiation with ^{60}Co γ irradiation significantly depressed $^{14}CO_2$ production, the degree and persistence being dose-related. Critical burn injuries resulted in decreased rates of $^{14}CO_2$ production, which decreased as the clinical condition of animals deteriorated. Because the most significant decrease occurred within the first 30 min, measurement of the initial rate of ^{14}C-propionate utilization was sufficient to detect altered metabolic states. High-resolution radioanalyses of urinary organic acids show the major ones excreted to be propionate and its immediate catabolites, methylmalonate and succinate, in both control animals and animals exposed to experimental injuries. These results suggest that propionate metabolism may be one of the sites in intermediary metabolism that is sensitive to alteration by experimental injuries and thus may be one of the more sensitive metabolic indicators. (auth)

36429 EXTRACTION AND PURIFICATION OF RADIOPROTECTIVE SUBSTANCE FROM CALF THYMUS. Funakoshi, Satoshi (Teikoku Hormone Mfg. Co., Ltd., Kawasaki, Japan); Sudo, Tadamitsu; Manita, Hideaki; (and others). J. Radiat. Res.; 12: No. 3-4, 105-16(Sep-Dec 1971).

A basic substance was obtained from calf thymus by acid extraction and further purified by CM-cellulose column chromatography. The material showed a significant prolongation of survival and a promotion of recovery of lymphoid tissues of mice exposed to lethal dose of ionizing radiation, when administered intraperitoneally 10 minutes before irradiation. Furthermore, it was capable of inhibiting the occurrence of radioinduced leukemia in mice. The most active material (CM-3) purified by CM-cellulose column chromatography accelerated the recovery of nucleated cells of bone marrow in irradiated mice. This active fraction, CM-3, was found to be stable after heating at 100°C for 15 minutes and a basic protein with molecular weight of approximately 20,000. Similar fractions were also obtained from calf liver and spleen by the same extraction procedure. The spleen extract showed the survival effect to some extent in irradiated mice, but the liver extract was ineffective. (auth)

36430 EFFECT OF PANAX GINSENG ON THE ASCORBIC ACID AND NUCLEIC ACID CONTENTS OF VARIOUS TISSUES IN THE ^{60}Co IRRADIATED RABBITS. Lee, Ki Yung; Kim, Han Seob; Cheon, Hyeong Won; Ahn, Hyun Jin; Choi, Young Jo. Korean Biochem. J.; 2: No. 1, 35-47(1969). (In Korean).

Observations were made on two parameters, that is, tissue ascorbic and nucleic acid contents, which are generally known to fall by irradiation. Reduction of these substances by whole-body gamma irradiation was confirmed in rabbits. However, the administration of aqueous ginseng extract to the rabbits in the amount of 20 mg/kg body weight for 10 days prior to the irradiations almost always prevented, with statistical significance, the otherwise reduced liver, splenic and adrenal ascorbic acid, and bone marrow and splenic nucleic acid (DNA and RNA) contents by irradiation. The protective effect of ginseng against anticipated lowering of tissue ascorbic and nucleic acids by irradiation was similar in degree whether the radiation was given 500 R and 800 R in dose. Brief reviews on the mechanisms of actions of chemical protectors are given, and on the basis of this, a logical direction for probing the mechanisms of protective action of Panax ginseng against radiation hazards was also indicated. (Korean Sci. Abstr.)

36431 EFFECTS OF HIGH DOSES OF ^{60}Co GAMMA IRRADIATIONS TO THE HEAD OF RAT ON THE GAMMA-AMINOBUTYRIC ACID, GLUTAMIC ACID, AND NUCLEIC ACID CONTENTS IN BRAIN TISSUE. Choi, Il. Korean Biochem. J.; 2: No. 1, 49-70(1969). (In Korean).

Studies were conducted on the effects of ionizing radiations to the head of experimental animals on the brain GABA, glutamic acid and nucleic acids (DNA and RNA), which are all important in brain biochemistry, and on the brain and serum total free amino acid nitrogen. Six, 24, 48, and 72 hours after a single dose of 6,000 to 10,000 R ^{60}Co gamma ray application to the head, with the body shielded, 3 rats from each group were sacrificed, and the brains rapidly removed; GABA and glutamic acid were determined paper chromatographically, the nucleic acids by Schmidt–Thannhauser's method, and total free amino acid nitrogen using the reaction with naphthoquinone sulfonic acid. (Korean Sci. Abstr.)

36432 X-RADIATION AND THE MANDIBULAR CONDYLE. Adkins, K. F. (Univ. of Queensland, Brisbane). Ala. J. Med. Sci.; 5: No. 4, 415-20(Jul 1968).

The effects produced in the condyles of rats by 1200 R of x-radiation were studied histologically. The marrow spaces were rapidly depleted of hemopoietic tissues and considerable fibrosis subsequently developed. Differentiation of mesenchymal cells into osteoblasts was temporarily impeded and as a result ossification close to the cartilage was reduced. Isolated functional chondrocytes were identified in the bony regions well away from the cartilage/bone interface. No similar features were seen in control animals. The femurs which were protected during irradiation were also studied histologically but no aberrations were noted. (auth)

36433 RADIATION BIOCHEMISTRY. VOLUME II. TISSUES AND BODY FLUIDS. Gerber, George B.; Altman, Kurt I. New York; Academic Press, Inc. (1970). 408p. $17.00.

The biochemical events and changes in metabolites and other molecules in selected mammalian tissues following local or whole-body exposure to ionizing radiations are described. The general aspects of radiation biochemistry are discussed and radioinduced changes in the bone marrow, erythrocytes, lymph tissues, gastrointestinal tract, liver, body fluids, miscellaneous organs, and tumors are described. (1850 references) (C.H.)

36434 RADIOBIOLOGICAL EFFECTS AFTER THREE-YEAR GAMMA-IRRADIATION OF DOGS. Grigor'ev, Yu. G.; Markelov, B. A.; Popov, V. I.; (and others). Kosm. Biol. Med.; 6: No. 1, 3-7(Jan-Feb 1972). (In Russian).

Results of a three-year radiobiological experiment on dogs are presented. In several experimental series, chronic irradiation with varied dose rates (21 to 150 rads per yr) and chronic irradiation combined with acute exposures (total doses of 120 and 190 rads per yr) were applied. Clinical hematological, physiological, and cytological examinations demonstrated that the animals maintained satisfactory clinical condition and had no serious organic radiation damages. However, a decline of their compensatory potentialities and a change of their reactivity were noted. (auth)

36435 EFFECT OF RADIOPROTECTANTS ON THE FUNCTIONAL STATE OF HISTO-HEMATIC BARRIERS IN ANIMALS. Sabaev, V. V.; Shashkov, V. S.; Sergeev, P. V.; Chistyakov, V. A.; Seidametov, M. A. Kosm. Biol. Med.; 6: No. 1, 7-10 (Jan-Feb 1972). (In Russian).

The effect of mexamine and cystamine on the membrane permeability of blood barriers of intact and restrained animals was studied. During the experiments, rats were kept under hypokinetic conditions for 10 days. Intraperitoneal injections of radioprotectants increased substantially the ^{131}I-albumin permeability of tissue barriers of most organs and tissues. In response to an injection of radioprotectants during the 10-day hypokinetic experiment, the label transfer through the hemato-encephalic barrier and tissue barriers of the femur and back muscles, the thymus, and adrenals increased to a lesser extent. (auth)

36436 REMOTE CYTOGENETIC EFFECT OF ACUTE IRRADIATION IN MONKEYS. I. LONG-TERM PERSISTENCE OF CHROMOSOME ABERRATIONS IN BONE MARROW CELLS OF MONKEYS. Kosichenko, L. P. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Genetika; 8: No. 3, 105-13(Mar 1972). (In Russian).

The objective of this study was the investigation of remote cytogenetic changes in bone marrow cells of four γ-irradiated (^{60}Co) monkeys at 410 to 650 R doses observed after 9, 10, 12, and 13 years after the irradiation. Long-term persistence of structural chromosome mutations exceeding significantly in frequency those in the control was observed. Chromosome aberrations, such as symmetrical translocations and pericentric inversions, were prevailing in irradiated monkeys. Chromatid aberrations appeared in the form of single fragments, insignificantly exceeding in frequency those in the control. New cell clones were found in 9 to 10 and 12 to 13 years after irradiation at 610 to 650 R doses. These cell clones were marked with different types of chromosome interchanges: an abnormal acrocentric in the 16 to 19th pair and an enlarged metacentric in the 1st pair. Structural chromosome changes described were stable and reproduced in repeated experiments. (auth)

36437 RADIOPROTECTIVE EFFECT OF GLUTATHIONE, WITH SPECIAL REFERENCE TO DOSE AND TIME OF ADMINISTRATION. Matsuoka, Shoji; Toda, Hiroshi; Sugiyama, Takeo (Morioka Red Cross Hospital, Japan). Shinryo To Shinyaku; 8: No. 10, 2013-15(Sep 1971). (In Japanese).

Intraperitoneal injection of glutathione was given to three groups of mice in the dose of 10, 20, and 30 mg, respectively, before whole-body x irradiation of 800 R, and one group of mice in the dose of 30 mg following x irradiation with the same dose. The radioprotective effect of glutathione was determined in terms of survival rate of the irradiated mice in contrast to the control. As a result, the effect was found to be proportional to the amount of glutathione administered. Therefore, it was certain that the mechanism consisted mainly of protection against radiation injuries. However, the administration of 30 mg of glutathione after irradiation was also effective. Accordingly, it is undeniable that glutathione was effective to some extent in recovery from radiation damage. (Japan)

36438 RESPONSE OF HISTIDINE DECARBOXYLASE ACTIVITY OF RAT STOMACH TO X-IRRADIATION. Kobayashi, Yutaka; Maudsley, David V. (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). Contract AT(30-1)-2085. Radiat. Res.; 50: No. 2, 301-8(May 1972).

X-irradiation results in a reduction in histidine decarboxylase activity of the glandular stomach of the rat. In nonirradiated animals, force feeding stimulates histidine decarboxylase activity about 4-fold in 3 hours but, in x-irradiated animals, this response is reduced by over 70%. In contrast, an injection of pentagastrin or insulin 24 hours after exposure to x-irradiation (2000 rads) produces a rise in histidine decarboxylase activity of the glandular stomach which is similar in magnitude to that obtained in nonirradiated animals. This increase in enzyme activity is prevented by cycloheximide but not by actinomycin D suggesting that synthesis of new messenger RNA may not be obligatory in the response of this enzyme system. The failure of food to stimulate histidine decarboxylase activity in starved, x-irradiated animals suggests that x-irradiation exerts an effect prior to the vagal release of endogenous gastrin. (auth)

36439 PERSISTENT MARROW HYPOCELLULARITY AFTER LOCAL X-IRRADIATION OF THE RABBIT FEMUR WITH 1000 RAD. Maloney, M. A.; Patt, H. M. (Univ. of California, San Francisco). Radiat. Res.; 50: No. 2, 284-92(May 1972).

Marrow regeneration was evaluated in rabbits after local x-irradiation of the femur with 1000 rad and after similar irradiation in conjunction with mechanical depopulation of the medullary cavity. In either case, there was a prolonged impairment of regeneration as revealed by the depression of marrow-cell concentration and thymidine incorporation into DNA. Moreover, a similar radiation effect was seen whether femur evacuation by dextran perfusion occurred immediately or 30 days after x-ray exposure. The cellularity deficit from several weeks to several months after femur irradiation alone was associated with a decrease in overall marrow blood flow. In general, these findings support the thesis that slowly reparable or irreparable damage to the marrow microenvironment is responsible for the persistent hypocellularity. (auth)

36440 EFFECT OF PROLONGED GAMMA-IRRADIATION ON LEUKOCYTE FUNCTIONAL ACTIVITY. Zubenkova, E. S. Kosm. Biol. Med.; 6: No. 3, 30-3(May-Jun 1972). (In Russian).

The results of studies on the functional activity of blood and bone marrow cells of 30 dogs exposed for three years to gamma-irradiation with different dose rates (0.06, 0.2 and 0.4 rads per day) are presented. Functional activity was assayed by measuring the osmotic resistance of leukocytes and by determining the viability of granulocytes during supravital staining. In irradiated animals the osmotic resistance of leukocytes decreased and the amount of cells with green fluorescence declined. These changes were detected a year after the beginning of the exposure. Specific investigations showed that the decline of functional activity of cells took place while they occurred in bone marrow. (auth)

36441 LABYRINTH REACTIONS OF DOGS EXPOSED TO LONG-TERM CHRONIC IRRADIATION. Kumets, P. I. Kosm. Biol. Med.; 6: No. 3, 33-7(May-Jun 1972). (In Russian).

A study of the functional state of the vestibular analyzer of dogs during a three-year period of chronic γ irradiation (total dose of 188 rads/year) revealed phasic and transient changes in the activity of the endolymphatic system of the diaphragm. (auth)

36442 NORMAL AUTOANTIBODIES AS A RADIOPROTECTIVE FACTOR. Klemparskaya, N. N. Kosm. Biol. Med.; 6: No. 3, 37-42(May-Jun 1972). (In Russian).

Experiments carried out on 1410 white mongrel female mice exposed to ^{60}Co γ irradiation (with a dose rate of 405 to 408 R/min), ^{137}Cs γ irradiation (with a dose rate of 0.31 R/min) and x irradiation (with dose rates of 72 r/min and 210 R/min) to provide a total uniform dose of 900 R demonstrated that the lower the dose rate the higher the content of normal antibodies in the blood and organs of the animals during the first 30 min after the exposure. Irradiation with the dose of 900 R given in two portions with a one hour interval also increased the occurrence of normal autoantibodies in the blood. There was a linear correlation between the dose rate, the injury severity, and the autoimmune process intensity during the peak of radiation reaction. Mobilization of normal autoantibodies in organisms irradiated with low dose rates may exert a protective effect and increase radioresistance. (auth)

36443 BIOLOGICAL EFFECTIVENESS OF PROTONS. Lomanov, M. F. Kosm. Biol. Med.; 6: No. 3, 88-90(May-Jun 1972). (In Russian).

Equilibrium conditions in a beam of protons and the relative biological effectiveness (RBE) of a proton beam as a function of energy were evaluated. An equality between the number of electrons produced and the number of secondary electrons lost in a medium was assumed. Proton energies from 13 to 660 MeV and their action at different depths of penetration in skin and other biological tissues are considered. At the lower proton energies the RBE $\ll 1$, increased to 0.88 at 200 MeV, and to 0.90 at 660 MeV. (K.S.W.)

36444 DIFFERENTIATION AND RADIORESPONSE (DOSE AND DOSE RATE) OF THE PRIMITIVE GERM CELL OF THE BOVINE TESTIS. Erickson, B. H.; Reynolds, R. A.; Brooks, F. T. (UT–AEC Agricultura Research Lab., Oak Ridge, Tenn.). Contract AT(40-1)-GEN-242. Radiat. Res.; 50: No. 2, 388-400(May 1972).

Two distinct forms of the gonocyte, or primitive germ cell, were delimited in the testis of the prepuberal bull. The most primitive of these, the type I gonocyte, gives rise through its mitoses to the type II gonocyte. Type II gonocytes were highly susceptible to the necrotizing effects of ionizing radiation. A dose of 19 rads killed 50% of their number and the residue was all but obliterated by a dose of 38 rads. The D_{37} for these cell's was estimated to be 25 rads. Conversely, the type I gonocyte was highly refractory to irradiation. Some of them survived a dose of 220 rads—a dose lethal to the calf. Gonocytic survival was unaffected by dose rate (0.12–28 rads/min). A dose of 38 rads or more will permanently impair the sperm-producing capacity of bulls irradiated between the 80th day of prenatal life and the 70th day of postnatal life with the magnitude of the effect diminishing as age at irradiation increases. Following exposures sublethal to the bull, increases in both numbers and activity of type I gonocytes plus the appearance of type A spermatogonia in Day 70 postnatal testis are believed to account for the diminution and eventual loss of a permanent testicular effect. (auth)

36445 EFFECT OF CONTINUOUS GAMMA IRRADIATION OF CHICK EMBRYOS UPON THEIR GONADAL DEVELOPMENT. Mraz, Frank R.; Woody, Madge C. (University of Tennessee, Oak Ridge). Contract AT-40-1-GEN-242. Radiat. Res.; 50: No. 2, 418-25(May 1972).

Fertile chicken eggs were continuously exposed to gamma rays at rates of 3.4, 1.8, or 1.0 R/hour. At specific intervals they were removed from the irradiation field and incubation was continued. These vacancies were filled with nonirradiated eggs containing embryos at comparable stages of incubation. At 20 days of incubation, all eggs were hatched under control conditions. At 2 weeks of age, the birds were sacrificed and their germ cells were counted. The testes of the controls were heavier than any of those from the irradiated birds. Irradiation administered at 3.4, 1.8, or 1.0 R/hour continuously to days 7, 11, or 15 of incubation, respectively, completely destroyed the germ cells. No spermatogonia were found in 2-week-old cockerels that received 3.4, 1.8, or 1.0 R/hour continuously from days 17, 15, or 7 of incubation, respectively, to day 20. Virtually no oocytes were found in pullets exposed to 3.4, 1.8, or 1.0 R/hour continuously from days 11, 9, or 3 of incubation, respectively, to day 20. Germ cells of the male were more resistant in the early stages of incubation than those of the female. However, at the later stages, the germ cells of the female were considerably more resistant than those of the male. (auth)

Invertebrates

36446 ^{32}P-RETENTION IN DNA IRRADIATED IN A REACTOR. EFFECTS OF THE VARIOUS SOLVENTS ON THE ^{32}P-RETENTION. Kawai, Kenichi; Akaboshi, Mitsuhiko (Kyoto Univ.). J. Radiat. Res.; 12: No. 3-4, 87-93(Sep-Dec 1971).

Phosphorus-32-retention in DNA was enhanced with increasing irradiation time when wet DNA was irradiated at −78°C. This suggested an extreme complexity of the mechanism underlying the retention. Thus, the effects of various solvents on the retention were examined as an approach to the elucidation of the mechanism of ^{32}P-retention. When DNA was irradiated with alcohols, ^{32}P retention in DNA was decreased markedly. This suggests that hot ^{32}P atoms were caught by alcohols or alcohol-originated radicals to yield the acid soluble fraction. From the experiments in which the other organic or inorganic compounds were added, the mechanism of ^{32}P retention in DNA is discussed. (auth)

36447 DYNAMICS OF POST-RADIATION DEATH IN AMEBAE RELATED TO THE IRRADIATION DOSE. Bychkovskaya, I. B.; ochinskaya, G. K. (Roentgen-Radiological Inst., Leningrad). Tsitologiya; 14: No. 1, 137-40(Jan 1972). (In Russian).

Amoeba proteus cultivated as individual lines was exposed to 190 kv x-rays at doses ranging within 0.1 to 400 kR. The step dependence of average life span of the lines upon the radiation dose was revealed. The 100% death of lines was registered at long terms after the irradiation with 0.1 kR, the average life span being about 40 days. A 400-fold increase of the dose (up to 40 kR) did not change the life span which was seen to decrease with doses of 60 kR or more. The step dependence of the damage on the radiation dose was confirmed in studies on the reproduction rate of the amoebae. (auth)

36448 EFFECT OF X-RAYS ON THE DEVELOPMENT OF MALE GENITAL IMAGINAL DISC IN DROSOPHILA MELANOGASTER AND INVESTIGATION OF RECOVERY BY CELL-CLONE ANALYSIS. Schweizer, Pascal (Univ., Zurich). Biophysik; 8: No. 2, 158-88(1972). (In German).

The developing capacity of the irradiated male genital imaginal disc in the male Drosophila melanogaster was investigated after irradiation of the abdomen during several stages of larval and pupal development (68, 92, and 116 hr old larvae; 10 and 30 hr old pupae). After irradiation with lowest effective doses (1500 R and 2000 R), the discs in the late third instar just prior to metamorphosis (116 hr old larvae) appeared to be the most affected. When one increases the doses up to 4000 R a shifting of the effect towards the mid-third instar (92 hr old larvae) is observed, while the disc in the late second instar (68 hr old larvae) appeared to remain unaffected. The prolongation of the larval life of the irradiated discs, by means of the transplantation in a younger larval host, improved the developing capacity of the irradiated primordians. Discs that would have developed rudimentary organs after irradiation and development in situ could be completely restored after transplantation into younger larvae. The assumption that the developing capacity of irradiated discs prior to metamorphosis depends in part on the amount of proliferative reparation processes that take place after irradiation, was tested by analyzing the size of genetically marked clones from radiation-induced somatic crossing over. A marked increase in clone size appeared with increased irradiation of second instar larvae, and a less marked increase after irradiation of third instar larvae. A comparison of the clone size after lower (1500 R) and higher (3000 and 4000 R) irradiation shows that the number of damaged cells in the imaginal disc are more equal at different larval stages than one would expect from the morphology of the imaginal genitalia. Hairs, which do not occur normally, were observed growing on injured cuticular structures. This observation is discussed in view of the well known transdetermination phenomena in the blastems of Drosophila melanogaster as well as the possibility of direct effect of irradiation on the hair-forming capacity of cells. (auth)

36449 STUDY OF THE EFFECTS OF GAMMA-RADIATION ON EGGS AND MIRACIDIA OF SCHISTOSOMA MANSONI. Antunes, C. M. F. (Instituto Nacional de Endemias Rurais, Belo Horizonte, Brazil); Katz, Naftale; Milward de Andrade, R.; Mansur Neto, E.; Lima, J. M. Rev. Inst. Med. Trop. Sao Paulo; 13: No. 6, 383-6(Nov-Dec 1971).

Schistosoma mansoni eggs and miracidia from human feces were irradiated with ^{60}Co, the doses varying from 0.5 to 200 Krad. Biomphalaria glabrata were exposed either to miracidia from irradiated eggs (10 to 200 Krad) or to irradiated miracidia themselves (1 to 50 Krad). In both experiments the miracidia penetrated the snails, but they did not develop. However, when using 0.5-Krad-irradiated miracidia, infection could be detected in 3.2% of the snails. Groups of B. glabrata were exposed to irradiated miracidia (0.5 Krad), and, later on, after periods of respectively, 10, 20 and 30 days, these groups were re-exposed to non-irradiated miracidia. The percentages of infection were, then, seen to be 62.2, 83.3 and 77.7%, respectively. These data show that previous infection with irradiated miracidia could not render the snails immune. (auth)

Radionuclide Effects (Internal Source)

36450 (AEC-tr-7300) EFFECTS OF ^{210}Po ON THE ORGANISM. Moroz, B. B.; Parfenov, Yu. D. Translation of Deistvie ^{210}Po na Organizm, Atomizdat, Moscow, 1971. 170p. Dep. NTIS.

The following topics are discussed in the nine chapters of the report: physicochemical properties of polonium; ^{210}Po in nature; metabolism and toxicology of ^{210}Po; biological effects of ^{210}Po; reactions of the sympatho-adrenal and cardiovascular systems to ^{210}Po; and electrolyte metabolism. (H.L.W.)

Man

Refer also to abstracts 36564 and 37721.

36451 (ORNL-4720, pp 116-31) INTERNAL DOSIMETRY. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

ATOMIC CLOUDS—radiation dose to man immersed in, method for calculation of beta and electron, p. 125-127

BETA PARTICLES—dose to man during immersion in radioactive cloud, method for calculation using standard man phantom, p. 125-127

ELECTRONS—dose to man during immersion in radioactive cloud, method for calculation using standard man phantom, p. 125-127

FETUSES—radiation dose to human, from gamma emitting radioisotopes in maternal bladder, computer calculations for using mathematical model of pregnant woman, p. 119-120

GAMMA RADIATION—dose to human fetuses of, from radioisotopes in maternal bladder, computer calculations for using mathematical model of pregnant woman, p. 119-120

GONADS—radiation dose to human, from radioisotopes deposited in other body tissues, methods for calculation using build up factor and computer analysis of decay data, p. 121-124

MAN—radiation dose to fetuses of, from gamma emitting radioisotopes in maternal bladder, method for calculation of, p. 119-120

—radiation dose to gonads of, from radioisotopes deposited in other body tissues, method for calculation of, p. 121-124

—radiation dose to, during immersion in radioactive cloud, method for calculation of beta and electron, p. 125-127

—radiation dose to, following uptake of thorium-232, method for calculation of, p. 128-131

RADIATION—dose to human gonads from radioisotopes deposited in other body tissues, method for calculation using computer analysis of decay data and buildup factor, p. 121-124

THORIUM-232—radiation dose to man following uptake of, method for calculation using metabolic model and computer analysis of decay data, p. 123-131 (C.H.)

Animals

36452 (AEC-tr-7304, pp 115-20) PECULIARITIES OF THE POSTNATAL DEVELOPMENT OF OFFSPRING OF MALE RATS TREATED WITH ^{241}Am. Ovcharenko, E. P. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 570-4(1971).

The intravenous injection of ^{241}Am into male rats in amounts from 0.005 to 0.002 μCi/g 1 to 10, 180, and 270 days before mating led to a decrease in viability, slowdown of physical development, reduction of the levels of erythrocytes, hemoglobin, and leukocytes in the peripheral blood, a decrease in the sexual function, and an increase in the radiosensitivity of their progeny. The sensitivity of the sex glands of males to the administration of ^{241}Am is four times lower than in females. To obtain full-valued progeny from males during the entire reproductive period, the amount of ^{241}Am administered intravenously should not exceed $\sim$0.0001 μCi/g. The safe amount of ^{241}Am for the progeny is 2 to 20 times lower than for adult male rats. (tr-auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 36075 and 36093.

Man

Refer also to abstracts 36564 and 37721.

36453 (FOA-4-4489) IMPORTANCE OF THE INTRACELLULAR DISTRIBUTION OF RADIONUCLIDES IN THE HUMAN BODY. PRELIMINARY DISCUSSION OF ^{90}Sr AND ^{55}Fe. Rydberg, Bjoern (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1972. 21p. (In Swedish). Dep. NTIS (U. S. Sales Only).

36454 (ORNL-4720, pp 23-9) DOSE ESTIMATION STUDIES RELATED TO PEACEFUL USES OF NUCLEAR EXPLOSIVES AND OTHER RADIONUCLIDE RELEASES. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

ENVIRONMENT—radioactive following continuous release of radioisotopes to, Cumulative Exposure Index for estimation of dose to human population from, p. 24-28

FOOD CHAINS—radioisotope transport through terestrial, computer calculations of kinetics of, p. 24-28

NATURAL GAS—production from nuclearly stimulated wells, effects of combustion of, on public health, p. 23-24

—tritium content of, from nuclearly stimulated wells, comparison of Gasbuggy with Rulison

PLOWSHARE PROJECT—effects of combustion of Gasbuggy and Rulison natural gas on public health, p. 23-24

POPULATIONS—radiation dose to human, following continuous release of radioisotopes to environment, estimation using Cumulative Exposure Index, p. 24-28

PUBLIC HEALTH—effects of combustion of natural gas from nuclearly stimulated wells on, p. 23-24

RADIATION—dose to human populations following continuous release of radioisotopes to environment, development of Cumulative Exposure Index (CUEX) for estimation of, p. 24-28

RADIATION STANDARDS AND UNITS—definition of Cumulative Exposure Index for estimating radiation dose to human populations following continuous release of radioisotopes to environment, p. 24-28

RADIOISOTOPES—transport through terrestrial food chains, computer calculations of kinetics of, p. 24-28

TRITIUM—content of natural gases produced from nuclearly stimulated wells, comparison of Gasbuggy with Rulison, p. 23-24 (C.H.)

36455 RESULTS OF INDIVIDUAL SURVEY MEASUREMENTS BY MEANS OF THE EXPERIMENTAL WHOLE-BODY COUNTER OF THE NATIONAL CENTRE FOR RADIATION PROTECTION OF THE GDR (1968 THROUGH 1970). Poulheim, K.-F. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Kernenergie; 14: No. 9, 305-7(Sep 1971). (In German).

The incorporation of ten radionuclides was quantitatively determined with a whole-body counter in 405 persons, 285 of whom worked in industrial facilities and 120 in research establishments using radioactive material. In 65% of the persons, incorporation was significant but the activities were generally low. The industrial group showed significantly higher incorporation than the research group. Frequently, simultaneous incorporation was found for ^{54}Mn, ^{60}Co, and ^{131}I. To obtain a reference level, ^{137}Cs was determined in a segment of the Berlin population. Since early in 1967, the mean value ranged around 80 pCi/kg. During the spring of each year, the values showed a minimum. (H.B.G.)

36456 ^{90}Sr IN DECIDUOUS TEETH IN FINLAND. Rytoemaa, Inkeri (Univ. of Helsinki). Acta Odontol. Scand.; 30: Suppl. 60, 5-29(1972).

The ^{90}Sr content of deciduous teeth in different localities in Finland from children born between 1952 and 1964 was measured. The effects of a number of variables such as type of tooth, ethnic origin of tooth donor, and year of birth were studied. A method, based on Cherenkov radiation, for measuring ^{90}Sr in teeth was developed. The literature concerning fallout ^{90}Sr in the human diet, bones, and teeth is briefly reviewed. (E.R.B.)

36457 THEORETICAL ASPECTS OF RADIOACTIVE TRACER STUDIES. Matthews, C. M. E. (Christian Medical Coll., Vellore, India). pp 236-57 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

Theoretical aspects of the use of radioisotopes as tracers in clinical diagnostic tests are reviewed. It is pointed out that, since the body is a complex of many interdependent processes, a simplified model of the system is needed in order to analyze data from tracer studies. A biological model may be developed with compartments that may represent anatomical, biological, chemical, or physical subdivisions. Applications of single, dual, and multicompartment systems for calculations of the distribution kinetics of radioactive tracers are described. The advantages of the use of computer calculations for analysis of data are discussed. (C.H.)

Animals

Refer also to abstracts 36073 and 36400.

36458 (AEC-tr–7304, pp 110-14) TRANSFER OF TRANSURANIUM ELEMENTS TO THE OFFSPRING OF RATS WITH MILK. Ovcharenko, E. P. (Inst. of Biophysics, Moscow). Translated from Radiobiologiya; 11: No. 4, 566-9(1971).

The content of transuranium elements in the bodies of lactating rats over a period of 30 days after giving birth was at the same level and was 75.2 ± 7.68 to 96.4 ± 18.8% of that introduced for ^{239}Pu, 67.6 ± 2.38 to 93.4 ± 12.72% for ^{241}Am, and 66.0 ± 0.418 to 96.0 ± 9.44% for ^{237}Np. The dynamics of the change in the content of transuranium elements in the bodies of baby rats fed by the treated mother was the same. The highest values were noted in the first 10 days. During the entire period of milk feeding, the highest content in the entire litter was detected after the administration of ^{239}Pu, less after the administration of ^{241}Am, and the least after ^{237}Np. (tr-auth)

36459 (AEC-tr–7304, pp 191-4) SOME PRINCIPLES OF THE PREDICTION OF THE TRANSPORT OF ^{90}Sr AND ^{137}Cs IN THE ANIMAL ORGANISM. Kogotkov, A. Ya.; Buldakov, L. A.; Burov, N. I. Translated from Radiobiologiya; 11: No. 4, 624-6(1971).

The experimental data of many authors on the accumulation and elimination of strontium-90 and cesium-137 in various species of animals were compared with their body weight. Systems of straight lines describing the relationships between the accumulation and elimination of strontium-90 and cesium-137 and the body weight were obtained. Knowing the quantitative characteristics of some index for two animals (or for one species of animals, but of different weights), the parameters of this index can be determined for other species of animals, on the basis of their weight. The dependence obtained can serve as the basis for predicting the accumulation of radioisotopes in the human organism. (tr-auth)

36460 (SRO–154) STATUS OF SAVANNAH RIVER PLANT DEER HERD. (Savannah River Operations Office (AEC), Aiken, S. C.). Apr 1972. 19p. Dep. NTIS.

A separate abstract was prepared on one section of the report. The other section discusses deer herd dynamics. (H.L.W.)

For abstract of individual section see: 36461.

36461 (SRO–154, pp 15-19) RADIOLOGICAL MONITORING RESULTS FOR THE 1971 DEER HUNTS. Rabon, E. W. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Apr 1972.

In Status of Savannah River Plant deer herd.

Eight hogs and 865 deer were killed on the Savannah River Plant reservation during 1971. The meat was measured for ^{137}Cs content. Results from mountainous and lower coastal plain areas are compared. The tabulated results show that no animal exceeded 48 picocuries per gm of meat and that the average concentration of ^{137}Cs was 11 picocuries per gm. Zinc-65 was detected in the muscle tissue of three deer. (H.L.W.)

36462 KINETICS OF ^{85}Sr AND ^{131}I, INTRODUCED SIMULTANEOUSLY INTO THE ORGANISM. Nikolov, Iv.; Vasilev, G.; Mihaylov, M. A.; Bokova, N.; Filev, G. Rentgenol. Radiol.; 9: No. 4, 256-61(1970). (In Russian).

Studies were conducted to investigate the radiation effect of isotopes, different in characteristics, introduced simultaneously into the organism. Strontium-85 (5μ Ci) and iodine-131 (10μ Ci) were introduced into the stomach of rats—simultaneously and separately. The indices for checking on the kinetic effects of the isotopes were the general activity, activity of the thigh bone, and thyroid gland. An analysis of the results revealed that the simultaneous introduction of strontium-85 and iodine-131 into the organism exerts an effect on the kinetics of each radioisotope. The kinetic changes lead to respective changes of the tissue doses received by the whole body and the separate critical organs. The whole-body dose received from iodine-131 is augmented 1.8 times and from strontium-85—3.2 times. On account of the retarded elimination of strontium from the organism, by the presence of iodine-131, the thigh bone received a dose 2.7 times greater than the one received by the independent introduction of strontium-85. At the same time, accumulation of iodine into the thyroid gland was slightly reduced—the measured doses are 1.2 times smaller than the ones by introduction of iodine-131 only. (Abstr. Bulg. Med. Sci. Lit.)

36463 INTERSPECIES MODEL FOR RETENTION ON INHALED PARTICLES. Thomas, Robert G. (Lovelace Foundation for Mecial Education and Research, Albuquerque, N. Mex.). Contract AT(29-2)-1013. pp 405-20 of Assessment of Airborne Particles. Fundamentals, Applications, and Implications to Inhalation Toxicity. /Mercer, Thomas T. (ed.). Springfield, Ill.; Charles C Thomas, Publisher (1972).

From third international conference on environmental toxicity; Rochester, N. Y. (18 Jun 1970).

A model has been developed which may be applied to mouse, rat, and dog, to describe the kinetics of clearance of inhaled particles from the respiratory tract, and the uptake and excretion kinetics of this cleared material. Emphasis has been placed on the tracheobronchial lymph nodes as a storage site for cleared particles, with uptake being described as a constant fraction of the amount of the deposited substance remaining in the respiratory tract at any time. First-order kinetics have been used to describe most of the translocation processes, and a very long-life of retention (several thousand days) has been used for lymph nodes and one compartment of the lung. The rate constants have been described in terms of speculative physiological processes, as they may be affected by particle size and solubility. One advantage of this model is the ability to readily alter one or two constants and be able to obtain rather precisely a reasonable fit to experimental data points. Close agreement with results calculated from the model was attained with data from several sources, comparing lung and lymph node content with time after inhalation of radioactive aerosols. (auth)

36464 WORLD-WIDE DEPOSIT OF ^{137}Cs IN ORGANS AND TISSUES OF SHEEP IN RELATION TO THE FEEDING CONDITIONS. Zotov, B. G. (Inst. of Veterinarian Research, Uzbek, USSR). Uzb. Biol. Zh.; No. 5, 23-5(1971). (In Russian).

The content of ^{137}Cs in the organs and tissues of sheep as a result of global fall-out was studied. On Uzbekishan pastures sheep consumed ^{137}Cs with natural grass by a factor of 12 to 15 times the rate noted during feeding cottonseed hulls and meal in one particular farming system. Lumbar muscles took up the largest fraction of ^{137}Cs of the tissues tested. (K.S.W.)

36465 STUDIES ON THE UPTAKE AND RELEASE RATES OF THE RADIOISOTOPES IN EGGS AND FECES OF LAYING HENS. Chung, Y. C.; Lee, K. S.; Kim, K. Y. Korean J. Anim. Sci.; 12: No. 1, 21-30(1970). (In Korean).

This experiment was carried out in order to study the transfer of radioactive materials into eggs of laying hens. Eggs were taken as samples first at 3–4 days after injection of seven radioisotope ($^{85+89}$Sr, ^{45}Ca, ^{24}Na, ^{32}P, ^{35}S, ^{131}I and $^{55+59}$Fe) in dose of 80 μCi to the thigh muscle of laying hens of each experimental group respectively and then at one day intervals. They were divided into three parts: egg yolk, egg white, and egg shell. Uptake rate of the radioisotopes into the three parts of eggs and release rate in feces were investigated. The results obtained were as follows: Uptake rates of the radioisotopes into the egg yolk were the lowest at 3–4 days after injection and were the highest at different times (^{24}Na: $2\frac{3}{4}$ days, ^{45}Ca: $4\frac{3}{4}$ days, ^{32}P: $3\frac{3}{4}$ days, $^{85+89}$Sr and ^{35}S: $5\frac{3}{4}$ days, $^{55+59}$Fe: $6\frac{3}{4}$ days) and thereafter decreased gradually, showing the significance with $P < 0.01$ in process of time. Uptake rates into the egg white were the highest in the early states: ^{131}I at $\frac{3}{4}$ day, ^{35}S and ^{24}Na at $1\frac{3}{4}$ day, ^{45}Ca and $^{86+89}$Sr at $2\frac{3}{4}$ days, $^{55+59}$Fe and ^{32}P at $3\frac{3}{4}$ days, and then decreased significantly ($P < 0.01$). Uptake rate of $^{55+59}$Fe into the egg shell was the highest at $2\frac{3}{4}$ days and the others at $\frac{3}{4}$ day, and showed the decreasing significance with $P < 0.01$. Release rates of ^{32}P and $^{55+59}$Fe into the feces were the highest $1\frac{3}{4}$ day and the others at $\frac{3}{4}$ day, and then decreased significantly ($P < 0.01$) as the time elapses. (Korean Sci. Abstr.)

36466 KINETICS OF ENVIRONMENTAL ^{42}K EXCHANGE FOR POTASSIUM IONS OF FROG SKELETAL MUSCLE FIBERS. Sorokina, Z. O. (Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR; 17: No. 6, 765-8(Nov-Dec 1971). (In Ukrainian).

On the basis of data on exchangeability of potassium ions of the frog skeletal muscles for environmental radioactive ions, kinetics of ^{42}K entering into muscle fibers were analyzed. The potassium flow is in a non-linear dependence on this ion concentration in the environment and is subjected to the Michaellis–Menten saturation kinetics. The value of this process activation energy in Ringer's normal solution proved to be of the same order as fermentation reactions. On the contrary, in muscles treated with inhibitors small values of activation energy correspond to a diffuse character of the reactions. A conclusion is made that about half of the potassium flow inside muscle fibers occurs by means of fermentation with formation of an intermediate enzyme-substratum complex. (auth)

36467 TRITIATION OF ANIMALS FROM TRITIATED WATER. Hatch, Frederick T.; Mazrimas, Joseph A. (Univ. of California, Livermore). Radiat. Res.; 50: No. 2, 339-57(May 1972).

Mice were given tritiated water (HTO) to drink for 40–147 days at a specific activity of 94 ± 4.8 μCi/ml (mean ± SD). Tissue HTO was 77.8 ± 10.1 μCi/ml in liver, testis, and intestinal mucosa, reflecting the input of H_2O in unlabeled food and metabolic H_2O. Bound T specific activity was 15.8 ± 6.0 μCi/g dry matter. Kangaroo rats (Dipodomys merriami) were given periodic HTO injections and fed a dry diet, with similar results. In both species the specific activity of nonaqueous tissue hydrogens was 25–40% that of hydrogen in tissue HTO. The total soft tissue radiation dose was estimated to be over 2000 rads. In the mouse nonexchangeable T in liver DNA had a specific activity 12% that of hydrogen in tissue HTO; and all four bases were labeled. An apparent tritium isotope effect was observed in the lungs. The specific activity of expired HTO vapor relative to tissue HTO was 0.44 in kangaroo rats and 0.64 in mice. (auth)

Plants

36468 (RISO–256, pp 163-75) DIRECT CONTAMINATION OF BARLEY WITH ^{7}Be, ^{22}Na, ^{115}Cd, ^{125}Sb, ^{134}Cs, AND ^{133}Ba. Aarkrog, A. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.

In Aspects of research at Risoe.

Radionuclides (^{7}Be, ^{22}Na, ^{115}Cd, ^{125}Sb, ^{134}Cs, and ^{113}Ba) were applied as a spray to barley plants at six different stages of development. Initial retention (IR), distribution between grain, husks, and straw, field loss (FL), and the normalized specific activity (NSA) of the different nuclides were determined. The percentage IR was approximately equal to the age of the plants in days at the time of contamination. Sb, Na, and especially Cs were translocated to the grain from other parts of the plants. This was not the case with Be, Ba, and Cd. FL followed a two-exponential decay for all nuclides except Na. The field loss coefficients were 0.08–0.21 days^{-1} in the first part of the growth period and 0.03–0.04 days^{-1} in the second part. Cd showed the lowest FL, Sb the highest. NSA varied from approx. 2 $m^2 \cdot day \cdot kg^{-1}$ (Be and Ba) to 7.4 (Cs). The direct contamination of barley grain from Cd in precipitation was estimated. (auth)

36469 (RISO–256, pp 177-86) EFFECTS OF NITROGEN NUTRITION ON THE UPTAKE, DISTRIBUTION, AND CHEMICAL BINDING OF STRONTIUM AND CALCIUM IN OAT PLANTS. Andersen, Arna J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.

In Aspects of research at Risoe.

The uptake of added radioactive Sr and Ca increased almost linearly with increasing supply of NH_4NO_3 to the soil. The ^{85}Sr/^{45}Ca ratio varied between plant parts, being lower in leaves, glumes, pales and grain than in stems and flower stalks. This indicates that discrimination against ^{85}Sr relative to ^{45}Ca occurs during transfer of the two ions from the conducting system. The compounds of stronger chemical bindings contained more ^{85}Sr than ^{45}Ca. This may explain some of the discrimination against ^{85}Sr during the transport of the two ions within the plants, but it cannot account for the very low ^{85}Sr/^{45}Ca ratio obtained in grain with high N supply. An active N-dependent discriminatory mechanism is assumed to regulate the transfer of Sr and Ca to oat grain. (auth)

New Tracer Techniques

Refer also to abstracts 36092, 36100, and 36101.

36470 (STI/DOC–10/60(3rd Ed.)) LABORATORY TRAINING MANUAL ON THE USE OF RADIONUCLIDES AND RADIATION IN ANIMAL RESEARCH. Technical Reports Series No. 60. (International Atomic Energy Agency, Vienna (Austria)). Feb 1972. 180p. IAEA $5.00.

The manual contains lecture material on properties of radionuclides and radiations, radiation detection, radiation protection, tracer techniques, neutron activation analysis, neutron moderation methods, and gamma-ray attenuation techniques. A set of laboratory exercises paralleling the lecture material is included. Applications of the basic lecture material in animal research are discussed and a second set of laboratory exercises, designed to put these applications into practice, is included. (E.R.B.)

36471 PLASMA DIGOXIN LEVELS IN DIGITALIZED AND TOXIC PATIENTS. Johnston, C. I.; Pinkus, N. B.; Down, M. (Univ. of Melbourne, Heidelberg, Australia). Med. J. Aust.; 1: No. 17, 863-6(22 Apr 1972).

The use of a simple, specific, and accurate radioimmunoassay for measuring plasma digoxin levels in patients is described. The assay, using unextracted plasma, can be performed in less than 1 hr. The level found in digitalized patients is between 0.5 and 2.0 ng/ml. Patients with criteria of digitalis intoxication evident from clinical and ECG examinations have levels greater than 2.0 ng/ml. In this series of toxic patients, the patient's age, the severity or type of cardiac disease, and the plasma potassium levels in the patients bore no relationship to the development of toxicity. However, the majority of the patients with digitalis toxicity and high plasma digitalis levels had renal insufficiency. (auth)

36472 VALUE OF TOMOGRAPHY IN LIVER SCANNING. DeLand, Frank H.; James, A. Everette; Muehllehner, G.; Wagner, Henry N. (Johns Hopkins Medical Institutions, Baltimore). Radiology; 102: No. 2, 429-32(Feb 1972).

In a preliminary study of 50 patients with suspected liver disease, tomography was of diagnostic aid in detecting and characterizing focal lesions and in defining unusual variations of normal anatomy. This method did not appear to be of additional value in the diagnosis of diffuse parenchymal disease of the liver. (auth)

36473 RADIOISOTOPES IN MEDICAL DIAGNOSIS. Belcher, E. H.; Vetter, H. (eds.). New York; Appleton-Century-Crofts (1971). 808p.

Separate abstracts were prepared on 11 chapters. Seventeen additional chapters discuss the use of radioisotopes as tracers to measure the absorption and distribution of various metabolites and one chapter discusses uses of radioisotopes in therapy. (C.H.)

For abstracts of individual chapters see: 35982, 36165–36169, 36397, 36398, 36457, 36474, and 36475.

36474 MULTIPLE TRACER TECHNIQUES. Veall, N. (Clinical Research Centre, Middlesex, Eng.). pp 158-70 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

Techniques for clinical diagnosis using two or more radioisotopes as tracers are discussed. Methods for measuring the activities of the different radioisotopes in the biological material by measuring the sample and the radiation standard under a number of different conditions and using different radiation detectors are described. Procedures for the chemical separation of each radioisotope in the sample are also described. The value of using multiple radioisotopes as tracers in certain metabolic studies and in simultaneous measurements of body water and electrolyte content and distribution, when as many as six different radioisotope tracers may be used simultaneously, is briefly reviewed. (C.H.)

36475 RADIOACTIVE TRACER TESTS IN VITRO. Ekins, R. P. (Middlesex Hospital, Eng.). pp 712-50 of Radioisotopes in Medical Diagnosis. /Belcher, E. H. (ed.). New York; Appleton-Century-Crofts (1971).

The uses of radioisotopes as tracers in the study of biological materials of medical interest in vitro are reviewed. Many such procedures relate to the measurement of concentrations of physiologically important substances in various body fluids. Analytical methods in current use include dilution analysis; radioactivation analysis; derivative analysis; and saturation analysis; which includes radioimmunoassay, competitive protein binding assay, radiostereoassay, displacement assay, and radioenzymatic assay techniques. The procedures used are described and the sensitivity of each method for clinical applications is evaluated. (C.H.)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 35985, 36108, 36113, 36528, 36538, 36588, 36590, 36611–36613, 37752, 37776, 37782, 37787, and 37987.

36476 (AECL–3677) MEASUREMENT OF WORK OF FRACTURE IN HIGH STRENGTH BRITTLE MATERIALS. Simpson, L. A.; Wasylyshyn, A. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Feb 1972. 30p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

A brief review is given on the theory and practicability of modern techniques of work of fracture measurements when applied to strong brittle ceramic materials. Included are both energy balance methods and direct measurements of the work required to produce a unit area of fracture surface. It was concluded that when the machining costs of specimens is high and/or the microstructure is inhomogeneous, the latter technique is more convenient. However, care must be taken to minimize energy losses due to rapid crack propagation. The survey was illustrated by some experiments using GE Lucalox alumina. The work of fracture of this material was found to be 2 to 3.5×10^4 ergs/cm^2, depending on microstructure. (auth)

36477 (AECL–4151) CONTRIBUTION TO THE STUDY OF THE URANIUM–SILICON EQUILIBRIUM DIAGRAM. Vaugoyeau, H.; Lombard, L.; Morlevat, J. P. Translated by M. A. Feraday (Atomic Energy of Canada Ltd., Chalk River, Ont.), from J. Nucl. Mater.; 39: No. 3, 323-9(Jun 1971). 17p. Dep. NTIS (U. S. Sales Only).

The character of the uranium–silicon equilibrium phase diagram in the compositional region between 50 and 70 at. % silicon is described. The single phase regions relating to the phases USi, U$_3$Si$_5$, USi$_{1.88}$ were determined, and the peritectic nature of the first and the last of these compounds is described. The hexagonal phase U$_3$Si$_5$ was found to be a congruent melting compound. A new tetragonal crystalline structure, a uranium monosilicide, has also been found. (auth)

36478 (AERE-R–7024) LONG-TERM ISOTHERMAL ANNEAL, THERMAL GRADIENT AND GAS RELEASE STUDIES OF AGR URANIUM DIOXIDE PELLETS. Harrison, K. T.; Munro, W.; Scott, K. T.; Shedden, J. S. (Atomic Energy Research Establishment, Harwell (England)). Mar 1972. 29p. Dep. NTIS (U. S. Sales Only). UK 1.00 pound.

Characterization studies were carried out on 4 different batches of unirradiated AGR fuel pellets. The results of very long isothermal anneals at temperatures up to 1500°C show isotropic grain growth but there is no sign of the development grain boundary porosity. Anneals of up to 112 days under thermal gradients of up to 2000°C/cm also failed to reveal any development of this porosity. When specimens were crushed in very high vacuum the principal gases released from closed pores were methane, nitrogen and carbon monoxide. (UK)

36479 (ANCR–1048) DEVELOPMENT OF B$_4$C ALUMINUM FOILS AS CONTROLLABLE NEUTRON ABSORBERS IN ALUMINUM CLAD NUCLEAR REACTOR FUEL PLATES. Hayner, G. O.; Graber, M. J.; Gibson, G. W. (Aerojet Nuclear Co., Idaho Falls, Idaho). Mar 1972. Contract AT(10-1)-1375. 109p. Dep. NTIS.

An investigation has been made into the use of aluminum foils containing B$_4$C installed in or adjacent to the uranium–aluminum alloy cores of aluminum-clad plates for the fuel elements of nuclear test reactors. The effort was directed mainly toward the requirements of the Engineering Test Reactor (ETR). However, the results of the investigation will be applicable to other reactors using the same type fuel system. The results obtained indicate that the B$_4$C can be distributed along the center line of fuel plate "meat" in the ETR elements by starting with a 3 to 4 mil-thick aluminum foil containing B$_4$C. When this technique is used, the control over the B$_4$C may not be as good as when powder metallurgy procedures are used to make the fuel plate cores. However, it is more easily controlled than in uranium–aluminum alloys. The fuel plates also tend to have higher irradiation-induced swelling rates and lower blister anneal failure temperatures when made by the technique under investigation than when using the powder metallurgy procedures. The failures produced by this technique were found to originate in the B$_4$C-Al foils. However, this fuel design was found to be adequate for the ETR environment. (auth)

36480 (ANL–7875) CHEMICAL ENGINEERING DIVISION REACTOR SAFETY AND PHYSICAL PROPERTIES STUDIES SEMIANNUAL REPORT, JULY–DECEMBER 1971. Chasanov, M. G.; Fischer, J.; Fredrickson, D. R.; Gabelnick, S. D.; Leibowitz, L.; Tevebaugh, A. D.; Vogel, R. C. (Argonne National Lab., Ill.). Mar 1972. Contract W-31-109-eng-38. 41p. Dep. NTIS.

A report of the work on Reactor Safety and Physical Properties Studies performed in the Chemical Engineering Division at Argonne National Laboratory is given for the period July through December 1971. The report includes the following: final results for the measurement of the enthalpy of Na$_3$UO$_4$ from 500 to 1200°K and of (U$_{0.8}$Pu$_{0.2}$)O$_{1.97}$ from 2348 to 3005°K, data for the speed of sound in molten sodium from 736 to 1489°C, infrared spectral data on uranium oxide species obtained by matrix-isolation spectroscopy, tentative assignments for the vibrational frequencies and bond angle in UO$_2$, computer calculations of fission-product and fuel vapor pressures over mixed-oxide fuels up to 6000°K, results of tests using the electron-beam-heated thermal diffusivity apparatus, and final results of the distribution studies of fission products between molten UO$_2$ and iron. (auth)

36481 (GEAP–13745) SEFOR FUEL ROD FABRICATION, 1970–1971. Farwell, B. E.; Eggert, W. K. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1971. Contract AT(04-3)-540. 240p. Dep. NTIS.

Nuclear Fuel Services, Inc., Erwin, Tennessee fabricated fuel rods for the SEFOR Site during 1970 and early 1971. A description of the fabrication effort, quality assurance activities, and problem areas is summarized. (auth)

36482 (GU–5279) FAST REACTOR MIXED-CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM. Quarterly Progress Report No. 14, October 1970–June 1971. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). 1 Nov 1971. Contract AT(30-1)-3415. 57p. Dep. NTIS.

Activities in programs to develop PuC–UC fuel rods for LMFBR are summarized. Information is included on radiation testing of high-burnup fuel rods, low-density fuel pellet evaluation, fuel swelling and fission gas release, evaluation of Na-bonded fuels, performance of low-power subassembly in EBR-II, thermal behavior of carbide fuels, and design of a high-power fuel subassembly. (J.R.D.)

36483 (JPRS–55886) THERMOPHYSICAL PROPERTIES OF POWDERED METAL COMPOSITIONS OF THE SYSTEM Al$_2$O$_3$–Mo. Osipova, V. A.; Kryaar, Kh. A. Translated from At. Energ. (USSR); 32: No. 2, 162-3(Feb 1972). 3p. NTIS.

A complex method of monotonic heating was used as the basis of investigations on the thermophysical properties of powdered metal compositions of the system Al$_2$O$_3$–Mo. This permitted finding the group of thermophysical parameters (λ, a, and c_p) in the entire temperature range of heating as a result of carrying out a single test. The results showed that the temperature dependence of the coefficient of thermal diffusivity was analogous to that of the coefficient of thermal conductivity. Data are tabulated. (P.C.H.)

36484 (LIB/Trans–401(a)) STUDY OF THE GROWTH OF OXIDE ON ZIRCONIUM AND ZIRCALOY-2. David, G.; Gerschier, R.; Roy, C. Translated by P. J. F. Newton (Australian Atomic Energy Commission), from J. Nucl. Mater.; 38: No. 3, 329-39 (1971). 24p. Dep. NTIS (U. S. Sales Only).

An abstract of this article, prepared from the original language, appeared as NSA 25: 24650. (Australia)

36485 (LIB/Trans–401(b)) INFLUENCE OF THE ORIENTATION OF ZIRCONIUM MONOCRYSTALS ON THE GROWTH TEXTURES OF MONOCLINIC ZIRCONIA. Penelle, R.; Boisot, P.; Beranger, G.; Lacombe, P. Translated by P. J. F. Newton (Australian Atomic Energy Commission), from J. Nucl. Mater.; 38: No. 3, 340-2(1971). 6p. Dep. NTIS (U. S. Sales Only).

An abstract of this article, prepared from the original language, appeared as NSA 25: 55540. (Australia)

36486 (LIB/Trans–401(c)) DISCUSSION ON "X-RAY DIFFRACTION ANALYSES OF ZIRCONIA FILMS ON ZIRCONIUM AND ZIRCALOY-2." Lacombe, P.; Beranger, G.; Boisot, P.; Penelle, R. Translated by P. J. F. Newton (Australian Atomic Energy Commission), from J. Nucl. Mater.; 38: No. 3, 343(1971). 3p. Dep. NTIS (U.S. Sales Only).

An abstract of this article, prepared from the original language, appeared as NSA 25: 24649. (Australia)

36487 (MLM–1914) FURTHER STUDIES ON NEW HYDRIDIC RARE EARTH COMPOUNDS. Silver, G. L. (Mound Lab., Miamisburg, Ohio). 16 May 1972. Contract AT(33-1)-Gen-53. 11p. Dep. NTIS.

Novel hydrides of samarium, yttrium, and gadolinium prepared by dissolving these elements in acetic acid or monochloroacetic acid are described. The compounds appear to be similar to analogous rare earth compounds prepared by dissolving other rare earth metals in warm acids. The colors of these compounds may be due to the presence of impurities such as molybdenum. Thermogravimetric analysis of the gadolinium compound suggests that the hydrogen in this compound is not lost in a uniform manner when the compound is heated. (auth)

36488 (MLM–1918) MOLYBDENUM COATING OF ThO_2 AND $^{238}PuO_2$ PARTICLES. Jaeger, R. R.; Cohen, S. T. (Mound Lab., Miamisburg, Ohio). [1972]. 13p. (CONF-720410–5). Dep. NTIS.

From third international conference on chemical vapor deposition; Salt Lake City, UT. (24 Apr 1972).

Both the hydrogen reduction of MoF_6 and $MoCl_5$ were evaluated in a fluid-bed reactor to deposit molybdenum on $^{238}PuO_2$, $^{238}PuO_2-ThO_2$ solid solution, and ThO_2 microspheres and shards. Considerable attack of the ceramic surface by the acid fluoride species was observed. The resulting fluoride impurity significantly increased the neutron emission rate due to the $^{19}F(\alpha,n)^{22}Na$ reaction. The following observations were noted on the MoF_6 system: (1) The fluorine contamination increases with increased surface area of the substrate. (2) The fluorine contamination increases rapidly during the initial moments of the run, then tapers off. (3) A small quantity of fluorine residue remains in the molybdenum coating itself. Likewise $MoCl_5$ and/or HCl attack the substrates' surface. Results of an electron microprobe study show that the chloride residue is associated solely with the ceramic phase. (auth)

36489 (ORNL-TM–3703) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1971. Patriarca, P. (Oak Ridge National Lab., Tenn.). Mar 1972. Contract W-7405-eng-26. 292p. Dep. NTIS.

Research and development progress is reported on FBR oxide fuels, advanced fast breeder reactor fuels, FBR neutron absorber materials, FBR cladding and structural materials, steam generator materials, fabrication of reactor structures, nondestructive testing, properties of structural materials, UN fuels, W metallurgy, metallurgy of refractory alloys, and heat source fuel capsules. (J.R.D.)

36490 (ORNL-TM–3729) EVALUATION OF FAST-REACTOR-IRRADIATED BORON CARBIDE POWDERS. Copeland, G. L.; Yakel, H. L.; DuBose, C. K. H. (Oak Ridge National Lab., Tenn.). May 1972. Contract W-7405-eng-26. 23p. Dep. NTIS.

Boron carbide powders were irradiated by Hanford Engineering Development Laboratory in row 7 of the Experimental Breeder Reactor-II to burnups of 3.7 and 4.8% of ^{10}B (7.7 and 10×10^{20} $n,\alpha/cm^3$) at temperatures of 730 and 650°C, respectively. The powders were examined by transmission electron microscopy and x-ray diffraction as irradiated and after annealing for 1 hr at temperatures from 700 to 1900°C. As-irradiated powders contained platelike or ribbonlike cavities accompanied by complex strain fields. The unit cell volume had decreased about 0.4% by a decrease in the rhombohedral a parameter with only a small change in the angle α. After annealing at 1450°C for 1 hr, the lattice parameters had returned essentially to the unirradiated values. The cavities had grown to slab-shaped bubbles and the strain fields had essentially disappeared. At higher annealing temperatures the bubbles tended to become more equiaxed. (auth)

36491 (ORNL-tr–2599) STUDIES ON THE DIFFUSION OF METALLIC FISSION PRODUCTS AND HEAVY METALS IN THE COATING OF FUEL PARTICLES FOR HIGH-TEMPERATURE REACTORS. Engelhard, Juergen (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Translated for Oak Ridge National Lab., Tenn., from report JUL–752-RG. 101p. Dep. NTIS.

Experimental programs and test methods to investigate transport and evaporation processes of solid fission products and heavy metals in the coating of fuel particles for high-temperature reactors are described. Mathematical methods to determine diffusion and evaporation coefficients are presented. The fuel particles are irradiated in the reactor at low temperatures of up to about 400°C and undergo no burnup. Subsequently, the particles are annealed in vacuum of about 10^{-5} torr in order to induce fission product transport. Diffusion of ^{235}U, ^{232}Th, ^{233}Pa, ^{95}Zr, ^{95}Nb, ^{141}Ce, ^{103}Ru, ^{140}Ba, ^{137}Cs, and ^{131}I was measured. (M.C.G.)

36492 (RCN–166) POST-IRRADIATION EXAMINATION OF FUEL PIN R54-F05, IRRADIATED IN A SODIUM ENVIRONMENT. Kwast, H. (Reactor Centrum Nederland, Petten). Mar 1972. 93p. Dep. NTIS (U. S. Sales Only).

Fuel pin R54–F05 was irradiated in a sodium environment in the HFR Poolside Facility at Petten for some hours at a high heat rating. The fuel pin consisted of 50% enriched UO_2 pellets of 6 mm canned in an X–8 CrNiNb 16.13 stainless steel tube with an outer diameter of 6.7 mm and a wall thickness of 0.3 mm. The pin failed almost immediately after moving the capsule to the end position, being 57 mm from the core box wall. The maximum linear power was 900 W/cm. Failure occurred by melting of the canning at the top of the fuel stack at the interface of the 50 and 8% enriched UO_2 pellets. The gamma scan revealed that at these interfaces a power peak was present. Metallographic examination revealed that only at the location of the failure, the center of the fuel was molten. (Netherlands)

36493 (UNC–5270) FAST REACTOR MIXED-CARBIDE FUEL ELEMENT DEVELOPMENT PROGRAM. Thirteenth Quarterly Progress Report, July–September 1970. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). 18 Nov 1970. Contract AT(30-1)-3415. 40p. Dep. NTIS.

Results of evaluation of high-density PuC–UC fuel pellets after irradiation in EBR-II are reported. Work devoted to evaluation of low-density fuel pellets and investigation of swelling and fission gas release from unrestrained PuC–UC fuels is summarized. Other work is reported on evaluation of sodium-bonded fuels, performance of low-power subassembly in EBR-II, evaluation of PuC–UC thermal properties, and performance of high-power subassembly in EBR-II. (J.R.D.)

36494 THERMODYNAMIC PROPERTIES OF BERYLLIUM OXIDE IN THE LIQUID AND SOLID PHASES. Shpil'rain, E. E.; Kagan, D. N.; Barkhatov, L. S. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 842–4 (Sep–Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 926-8(Sep–Oct 1971).

A calorimeter with an evaporating liquid was used in the mixing method to measure the enthalpy of beryllium oxide in the liquid and solid phases in the temperature range 2000 to 3200°K. The test substance was under its own vapor pressure in hermetically sealed tungsten and molybdenum ampules. The experimental results are used to obtain the heat of fusion and heat capacity for the liquid phase of beryllium oxide, not previously reported. (auth)

36495 MECHANICAL PROPERTIES OF ZIRCONIUM OXIDE FILMS. Brook, P. A.; Howes, V. R.; Leach, J. S. L.; Nehru, A. Y. (Univ. of Nottingham, Eng.). pp 272-7 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Studies were made on the reduction in stress in anodic ZrO_2 at high growth rates. The results showed that increases in rate reduced the compressive stress in the oxide. Microscopic examination of the surface of Zr specimens anodized at varying current densities showed that with increasing current density there was a marked decrease in the occurrence of features in the film that might be attributed to the presence of compressive stresses. It was found that a model put forward to account for the relation between the stresses and ionic motion in Al_2O_3 films is applicable to the variation in stress in anodic ZrO_2 films, which was observed to be a function of the rate of oxidation. (P.C.H.)

36496 BRIDGE ISOMERISM IN SUBSTITUTED BORON HYDRIDES. Emel'yanova, N. V. (Kharkov State Univ.). Zh. Strukt. Khim.; 12: No. 5, 905-9(Sep–Oct 1971). (In Russian).

The number of isomers for substituted boron hydrides was calculated with replacement in the bridge bond. Similarly, the number of isomers formed by parallel substitution of hydrogen atoms both in bridge bonds and in B–H bonds was studied. A table of numbers of isomers is presented, with which the number of isomers may be calculated for any given configuration for parallel replacement. (tr-auth)

36497 FABRICATION AND IRRADIATION TESTING OF PuO_2–UO_2 FUELS. Iwasaki, K. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). Genshiryoku Kogyo; 17: No. 12, 30-3(Dec 1971). (In Japanese).

At the Power Reactor and Nuclear Fuel Development Corporation, development work has been in progress on PuO_2-UO_2 mixed fuel, including process and irradiation testing. On production of Pu fuel, processes for fuel pellet production such as coprecipitation and mechanical mixing, and fuel assemblies, as well as plutonium recovery, are described. For test irradiation of the Pu fuel done mainly with facilities in oversea countries, the following tests including those of radiographic, metallurgical, puncture, etc. are explained: fuel produced by the mechanical mixing, the co-precipitation and sol-gel vibration packing; preliminary test for pellets and the sol-gel packed fuel before irradiation in the Halden reactor; and irradiation of fuel assemblies in the Halden reactor. (Japan)

36498 PROCESS FOR THE PREPARATION OF URANIUM DIOXIDE AND PRODUCT PRODUCED THEREBY. (to Unisearch Ltd.). British Patent 1,271,475. 19 Apr 1972. Priority date 20 May 1969, Australia.

A method is described for the production of UO_2 by reduction of acid uranyl salt solution with a carbohydrate at a temperature between 60 and 300°C until the uranyl solution is reduced to UO_2. The advantages lie in the relatively few steps together with lower temperatures and pressures in general, very much shorter reaction time, the possibility of not using a catalyst, and low cost of the reducing agent. If a catalyst is to be used, it can be Pd or Pt. (P.C.H.)

36499 CONDITIONS OF FORMATION OF URANIUM TRIOXIDE. Vidavskii, L. M.; Lavut, E. G.; Ippolitova, E. A. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 816(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 789(Sep-Oct 1971).

Oxidation of U_3O_8 by oxygen at atmospheric pressure was studied. At 590 to 600°C, the formation of γ-UO_3 became appreciable after 500 h. After 700 h, this impurity became significant. At 860 to 870°K, there is an oxidation of lower oxides of uranium to γ-UO_3, but the rate of this reaction is low. (M.C.G.)

36500 INVESTIGATION OF THE HIGH PRESSURE PHASE $\alpha-U_2O_5$. Tsvigunov, A. N.; Kovba, L. M.; Savraskii, V. V.; Zubova, E. V. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 818 (Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 790(Sep-Oct 1971).

Single crystals of $\alpha-U_2O_5$ were prepared at high pressures and temperatures. The crystals belong to a monoclinic symmetry group with a base-centered cell and $a = 12.40 \pm 0.01$, $b = 5.074 \pm 0.005$, $c = 5.675 \pm 0.005$Å and $\beta = 99°12' \pm 6'$. (M.C.G.)

36501 TYPE OF SUPERSTRUCTURE IN THE PHASE $UO_{2.6}$. Kovba, L. M.; Tsvigunov, A. N. Sov. Radiochem. (Engl. Transl.); 13: No. 5, 817(Sep-Oct 1971).

Translated from Radiokhimiya; 13: No. 5, 789-90(Sep-Oct 1971).

A study of single crystals of uranium octoxide with a O/U ratio equal to 2.615($UO_{2.615}$) was carried out. The period of the subcell b is increased 13-fold, while the period of the subcell c is increased twofold. (M.C.G.)

36502 REFRACTORY RARE EARTH TUNGSTATE CERAMICS. Millet, J. (Electricite de France, Clamart); Dubois, J.; Benezech, G.; Canale, P.; Provost, G. Rev. Int. Hautes Temp. Refract.; 8: No. 3, 277-86(Jul 1971). (In French).

Rare earth tungstate ceramics (Dy, Eu, Er, Gd, Ho, La, Nd, Pr, Sm, Tb, Yb, and Y tungstates) having melting points higher than 1700°C were studied, in particular those of the R_6WO_{12} family. The preparation, mechanical properties, crystalline structure, electrical properties, and chemical properties of the ceramics were determined. Er and Y tungstate ceramics were found to be particularly refractory and resisted the action of molten salts. (France)

36503 SYSTEM $PbO–B_2O_3–H_2O$ AT 75^0C. Zdanovskii, A. B.; Smirnova, G. M.; Leont'eva, I. A.; Kalitina, L. N. (Inst. of Chemistry, Sverdlovsk, USSR). Zh. Neorg. Khim.; 17: No. 2, 514-16(Feb 1972). (In Russian).

The solubility of the following difficult soluble Pb compounds was studied in the $PbO-B_2O_3-H_2O$ system at 75°C: PbO, 4PbO $5B_2O_3 \cdot 2.5H_2O$, $PbO \cdot 2B_2O_3 \cdot 3H_2O$, and $3PbO \cdot 10B_2O_3 \cdot 9H_2O$. Monocrystallinity and the peculiarities of the solid phases specified were confirmed by means of electron microscopy, thermography, and other investigative techniques. (tr-auth)

36504 PHASE DIAGRAMS OF THE SYSTEMS FORMED BY YTTRIUM, ERBIUM, AND YTTERBIUM OXIDES WITH MAGNESIUM OXIDE. Tresvyatskii, S. G.; Lopato, L. M.; Ogorodnikova, A. A.; Shevchenko, A. V. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1798-1801(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2020-4(Nov 1971).

The methods of annealing and high-temperature DTA were used to construct phase diagrams of the systems Er_2O_3-MgO and Yb_2O_3-MgO, and Y_2O_3. The phase diagram of the system Y_2O_3-MgO was improved in the range 1500 to 2400°C. New phases were not detected in these systems. The effects of additives on the character of polymorphic transitions of rare earth oxides were established. Solid solutions based on the initial oxides were also investigated. (auth)

36505 FORMATION, STABILITY, AND ELECTRICAL PROPERTIES OF FLUORITE-LIKE SOLID SOLUTIONS IN THE SYSTEM $ZrO_2–MgO–P_2O_3$. Tikhonov, P. A.; Kuznetsov, A. K.; Keler, E. K. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1794-7(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2015-19(Nov 1971).

Ternary fluorite-like solid solutions in the system $ZrO_2-MgO-Y_2O_3$ were synthesized, and the region of stability of the cubic phase at 1200°C was determined. Studies on the formation kinetics of ternary solid solutions $ZrO_2-MgO-Y_2O_3$ gave information on the optimal conditions for obtaining high-refractory materials on their basis. The effects of the relative MgO and Y_2O_3 content on the resistivity and stability of ternary solid solutions were also considered. High-refractory materials, which are virtually stable in an inert atmosphere and air up to 2000°C and have relatively high resistivities, were obtained. (auth)

36506 STABILITY OF SOLID SOLUTIONS IN THE SYSTEMS $ZrO_2–Ln_2O_3$. Glushkova, V. B.; Keler, E. K.; Shcherbakova, L. G.; Shcherbovskii, E. Ya. (Inst. of Silicate Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1787-93(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2007-14(Nov 1971).

An x-ray microanalyzer and a high-temperature dilatometer were used to study the decomposition mechanism of ZrO_2-base solid solutions with La_2O_3, Nd_2O_3, Sm_2O_3, and Dy_2O_3. The results showed that the rate of decomposition of the solid solutions depended on the nature and amount of additive. Decomposition was also found to be slower in vacuum than in air. In practice, ZrO_2 may be stabilized by adding 3 to 4 mole % of oxides of heavy rare earths. (P.C.H.)

36507 PHASE DIAGRAM OF THE SYSTEM $Dy_2O_3–MoO_3$. Lysanova, G. V.; Gokhman, L. Z.; Evdokimova, N. G. (Inst. of General and Inorganic Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1802-5(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2025-8(Nov 1971).

The phase diagram of the system $Dy_2O_3-MoO_3$ has been studied. It has been established that five compounds with ratios Dy_2O_3 : MoO_3 equal to 1 : 4, 1 : 3, 1 : 1, 2 : 1, and 3 : 1 are formed in this system. The tetramolybdate $Dy_2O_3 \cdot 4MoO_3$ melts incongruently at 875°C and forms a eutectic with MoO_3. The normal molybdate $Dy_2O_3 \cdot 3MoO_3$ exists as three modifications (M, L, and C') with reversible phase transitions at 790 and 1015°C, melts congruently at 1225°C, and forms a eutectic with the oxymolybdate $Dy_2O_3 \cdot MoO_3$. Using the method of a solution in a melt, single crystals of the tetramolybdate $Dy_2O_3 \cdot 4MoO_3$ and of the L-modification of the normal molybdate $Dy_2O_3 \cdot 3MoO_3$ were grown for the first time. (auth)

36508 PHASE DIAGRAM OF THE SYSTEM Hf–B. Portnoi, K. I.; Romashov, V. M.; Romanovich, I. V.; Levinskii, Yu. V.; Prokof'ev, S. A. Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1769-72(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 1987-91(Nov 1971).

Using thermal, x-ray, microstructural, and local x-ray spectral analysis, alloys of the system Hf–B, obtained under different synthesis conditions, were investigated. The phase diagram of this system was constructed from the results. Data on microhardness, melting points, and microhardness of the phases in the system are tabulated. (P.C.H.)

36509 PHASE DIAGRAMS OF SYSTEMS FORMED BY RARE EARTH OXIDES WITH MOLYBDENUM TRIOXIDE. Rode, E. Ya.; Lysanova, G. V.; Gokhman, L. Z. (Inst. of General and Inorganic Chemistry, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1875-7(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2101-3(Nov 1971).

Studies were made on the systems $Ln_2O_3-MoO_3$, where Ln = La, Pr, Nd, Sm, Gd, Tb, Dy, and Er up to 50 mole %, and preliminary data were obtained for systems with Ln = Eu, Ho, Tm, Yb, and Lu by DTA and x-ray phase analysis. Mixtures of the oxides were subjected to stagewise annealing with intermediate grinding, first at 500°C and then at a higher temperature. The phase diagrams of the systems were constructed from the heating curves of the annealed specimens. The individual characteristic of the $La_2O_3-MoO_3$ was the incongruent character of melting of $La_2O_3 \cdot 3MoO_3$, whereas the normal molybdates of the other rare earths melt congruently. The systems $Ln_2O_3-MoO_3$ (Ln = Pr to Tb) were characterized by formation of hexamolybdate, by the isostructural nature of the tetramolybdates, and by the presence of a common structure of the normal molybdate. The systems

$Ln_2O_3-MoO_3$ where Ln = Dy to Yb were characterized by the absence of hexamolybdates, formation of isostructural tetramolybdates, and the presence of a common structure of the normal molybdates. Finally, the system $Lu_2O_3-MoO_3$ was characterized by the absence of formation of a tetramolybdate. In general the number of compounds formed decreased with increasing atomic number of the rare earths. (P.C.H.)

36510 BINARY SYSTEM $Cu_2O-B_2O_3$. Rza-Zade, P. F.; Abdullaev, G. K.; Eyubova, N. A.; Samedov, F. R. (Inst. of Inorganic and Physical Chemistry, Baku). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1872-4(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2098-2100(Nov 1971).

Studies were made on the system $Cu_2O-B_2O_3$ in the Cu_2O concentration range 10 to 85 mole % by differential thermal, x-ray phase, and ir spectroscopic analyses. The phase diagram of the system $Cu_2O-B_2O_3$ was constructed from the heating curves of the alloys and was confirmed by x-ray phase analysis data and ir absorption spectra. The results showed that the appearance of new intense diffraction maxima and absorption bands in the ir spectra were due to formation of compounds of the composition $Cu_2B_4O_7$ and $CuBO_2$. It was noted that all the specimens retained the absorption band maxima at 1144 to 1188 and 706 to 720 cm^{-1}, characteristics of boric oxide. With increasing Cu_2O content in the system, these bands were displaced somewhat toward the shortwave side. It was assumed that in $Cu_2B_4O_7$ and $CuBO_2$, the B atoms are mainly in triangular coordination. However, the presence of bands at 900 to 1100 cm^{-1} indicated that some B atoms have tetrahedral coordination with respect to oxygen in these compounds. (P.C.H.)

36511 REACTION OF NIOBIUM PENTOXIDE WITH THALLIC OXIDE. Plotkin, S. S.; Plyushchev, V. E.; Moiseeva, L. S. (Moscow Inst. of Fine Chemical Tech.). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1817-19(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2041-4(Nov 1971).

X-ray analysis, measurements of the electrical conductivity, and DTA were used to study the phase composition of the system $Tl_2O_3-Nb_2O_5$ at 20 to 750°C. It was found that the system contains two compounds: $TlNb_3O_9$ and $Tl_4Nb_6O_{11}$. The thermal stability in air and in oxygen, resistivity in different media, and certain other physical and chemical properties of these compounds have been determined. (auth)

36512 EFFECT OF CURRENT-BLACKENING ON THE ELASTIC CONSTANTS OF YTTRIA-STABILIZED ZIRCONIA. Farley, J. M.; Thorp, J. S.; Ross, J. S.; Saunders, G. A. (Durham Univ., Eng.). J. Mater. Sci.; 7: No. 4, 475-6(Apr 1972).

The passage of current through yttria-stabilized zirconia in reducing atmospheres produces visual blackening and leads to an increased friability of the material which restricts its use as a refractory electrode. To assess the effect of current passage on the elastic properties of the material, ultrasound wave velocities were measured in single crystal, 8 mole % yttria-stabilized zirconia before and after blackening by current passage. The results are tabulated from which it can be seen that the temperature dependencies were substantially the same. Within the experimental error the velocities were unaltered; the elastic constants in the as-grown and blackened states, and thus the lattice stabilities, were the same. In the blackened crystal there was a marked deterioration of echo quality and some intermediate echoes also appeared: the blackened crystal showed the characteristics expected in an inhomogeneous material. (UK)

36513 PRECIPITATION OF NIOBIUM HYDRIDE AT SUB-AMBIENT TEMPERATURES. Hardie, D.; McIntyre, P. (Univ. of Newcastle-upon-Tyne, Eng.). Metal Sci. J.; 6: 40-6(Mar 1972).

The precipitation of hydrogen from niobium containing <250 ppM hydrogen was studied at sub-ambient temperatures by internal friction, resistometric, and metallographic methods. Results indicated an athermal martensitic transformation requiring some prior ordering of hydrogen atoms. The hydride precipitated had a trigonal crystal structure arising from distortion of the niobium unit cell by local concentration of hydrogen. (auth)

36514 KINETICS OF SINTERING OF UO_2. Moorthy, V. K.; Soni, N. C. (Bhabha Atomic Research Center, Bombay). Trans. Indian Ceram. Soc.; 27: No. 6, 177-88(1968).

The kinetics of sintering of pellets prepared from UO_2 powders derived from ammonium diuranate at different calcination temperature were studied. The powders were calcined between 500 and 1500°C and the densification characteristics of the pellets made from these were evaluated for different soaking times from 10 to 1000 min at sintering temperatures between 1000 and 1500°C. Data were analyzed using the empirical equation D = C + K log Th t where D is the density, C and K are constants, and t denotes time. It was found that the progress of sintering, attainment of limiting densities, and variation in rates of densification of different temperatures and time can be explained on the assumption that material movement (hence densification) is governed by the number, nature, and energy of crystalline defects (flaws) in the original powders. (Indian Sci. Abstr.)

36515 PROPERTIES OF GLASS IN THE SYSTEM $SrO-TeO_2-V_2O_5$. Dimitriev, I. B.; Marinov, M. R.; Ivanova, I. I. (Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 24: No. 8, 1069-72(1971).

Studies were made on the activating energy of σ, crystallization capacity, and density of strontium glasses ($SrO-TeO_2-V_2O_5$). The results of activating energy showed that $\Delta E \sim 0.8$ to 1.2 eV with a V_2O_5 content below 15 mole %, ~0.5 to 0.7 eV when V_2O_5 was about 30 mole %, and ~0.4 eV for compositions with V_2O_5 40 to 50 mole % and SrO below 15 mole %. The density of the glass was increased in the direction of TeO_2, while the chemical stability had a more complex course. V_2O_5 also affected the chemical stability of the glasses. (P.C.H.)

36516 CHEMICAL BONDS IN TRANSITION METAL BORIDES. Samsonov, G. V.; Kovenskaya, B. A.; Serebryakova, T. I. (Inst. of Problems in Materials Management, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 12, 1127-9(Dec 1971). (In Ukrainian).

Some physical properties of different boride phases of niobium and chromium were investigated. The regularities found in the behavior of different properties in connection with a change in quantitative correlation of boron and metal atoms enable the suggestion of a possible scheme of interatomic bonds in the borides. (auth)

36517 EFFUSION-MASS SPECTROMETRIC DETERMINATION OF THE HEATS OF FORMATION OF THE GASEOUS MOLECULES V_4O_{10}, V_4O_8, VO_2, AND VO. Farber, Milton; Uy, O. Manuel; Srivastava, R. D. (Space Sciences, Inc., Monrovia, Calif.). J. Chem. Phys.; 56: No. 11, 5312-15(1 Jun 1972).

An effusion–mass spectrometric investigation of the vapor in equilibrium with the vanadium compounds, V_2O_5, V_2O_4, and V_2O_3, was conducted. The only congruently evaporating solid was V_2O_3, while the others decomposed to various vapors and V_2O_3 in the temperature range 1000 to 1200°K. The vapor over V_2O_5 was found to contain the compounds $V_4O_{10}(g)$ and $V_4O_8(g)$ with resulting $\Delta H_{f\,298}$ values of -681.2 ± 7 kcal/mole and -590.5 ± 7 kcal/mole, respectively. Results of a study showed that the vapor over V_2O_3 at 2270°K contained the species V(g), VO(g), and $VO_2(g)$, yielding values for ΔH_{f298} of 35.1 ± 4 kcal/mole and -56.3 ± 4 kcal/mole for VO(g) and $VO_2(g)$, respectively. (auth)

36518 SYSTEM Eu–Fe–O: COMPOUND FORMATION AND ITS IMPLICATIONS FOR SYSTEMATIC CRYSTAL CHEMISTRY. McCarthy, Gregory J.; Fischer, Rose D. (Pennsylvania State Univ., University Park). J. Solid State Chem.; 4: No. 3, 340-4 (May 1972).

Compound formation and phase relations at 1200°C have been studied for the $EuO-Eu_2O_3-Fe_2O_3-Fe$ portion of the system Eu–Fe–O. Only two ternary compounds, in both of which the europium was trivalent, could be prepared over the temperature range 1100 to 1400°C. The existence of seven ternary compounds containing divalent europium is predicted by the crystal chemical analogy of Eu^{2+} and Sr^{2+} compounds. None of these could be prepared. Divalent europium was found not to be stable in any phase assemblage with trivalent iron. This result is consistent with simple oxidation–reduction thermodynamics. The relevance of these results to systematic crystal chemistry is discussed. (auth)

36519 STUDY OF OXYGEN SORPTION ON CERIUM(IV) OXIDE BY ELECTRON SPIN RESONANCE. Gideoni, Michael; Steinberg, Menachem (Hebrew Univ., Jerusalem). J. Solid State Chem.; 4: No. 3, 370-3(May 1972).

The presence of paramagnetic species on the surface of cerium (IV) oxide prepared by the thermal decomposition of the oxalate at low temperatures (375°) was found by ESR. The sorption of oxygen at room temperature showed a new signal having $g_{\perp} = 2.0137$ and $g_{||} = 2.0312$. This signal is ascribed to the formation of the anionic radical O_2^- on the surface. The origin of the paramagnetic species is ascribed to quasi-free electrons in the n-type nonstoichiometric cerium(IV) oxide. (auth)

36520 PHASE STUDIES OF THE THORIUM OXIDE–LANTHANUM OXIDE SYSTEM. Keller, C.; Berndt, U.; Engerer, H.; Leitner, L. (Kernforschungszentrum, Karlsruhe, Ger.). J. Solid State Chem.; 4: No. 3, 453-65(May 1972). (In German).

In the thorium oxide–rare earth oxide systems a great solubility of $REO_{1.5}$ in ThO_2 can be observed. The width of this fluorite phase $(Th,RE)O_{2-x}$ increases with increasing temperature and strongly depends on the ionic radius of the lanthanide element. A maximum solubility exists in the $ThO_2-NdO_{1.5}$ system where the difference $[r_{Th^{4+}} - r_{RE^{3+}}]$ between the ionic radii is a minimum. The smallest phase width occurs in the $ThO_2-LuO_{1.5}$ system, where the difference between the ionic radii is greatest. The hexagonal (A-$REO_{1.5}$) and monoclinic (B-$REO_{1.5}$) rare earth oxides do not take up ThO_2 into solid solution, in contrast to the cubic (C-$REO_{1.5}$) oxides which show a small solubility (<5 mole %) for ThO_2. The incorporation of ThO_2 in C-$REO_{1.5}$ to give a C-type phase $(RE,Th)O_{1.5+x}$ stabilizes the cubic rare earth oxides against transformation to B-$REO_{1.5}$. Two new ordered phases, $ThO_2 \cdot 3REO_{1.5}$ and $ThO_2 \cdot 11REO_{1.5}$, were found in the systems with the light rare earth elements La, Pr, and Nd. These compounds are stable only at high temperatures, but can be obtained in a metastable state by rapid quenching. It has been shown by density measurements that in the fluorite phase $(Th,RE)O_{2-x}$ as well as in the C-type-phase C-$(RE,Th)_{1.5+x}$ a completely filled cation lattice exists with vacancies [in $(Th,RE)O_{2-x}$] or interstitials [in $(RE,Th)O_{1.5+x}$] in the anionic part of the lattice. Detailed phase diagrams showing phase equilibria for temperatures between 1250°C and 2100°C are given. (auth)

36521 USE OF THE ELECTRON SPIN RESONANCE OF Cu(II) IN THE INVESTIGATION OF GLASS STRUCTURE IN THE SYSTEM P_2O_5–B_2O_3–Cs_2O. Bogomolova, L. D.; Zachkin, V. A.; Lazukin, V. N.; Shapovalova, N. F.; Shmukler, V. A. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 201: No. 3, 563-6(21 Nov 1971). (In Russian).

The structural properties of glass in the system $P_2O_5-B_2O_3-Cs_2O$ were studied with EPR using Cu(II) ions as paramagnetic centers. A ternary diagram was constructed showing the regions of glass formation on the basis of EPR data, and the triangular area was delineated into five areas, varying in the content of $[PBO_4]$ groups and similar parameters. (K.S.W.)

36522 PHYSICOCHEMICAL INTERACTION OF SAMARIUM AND GADOLINIUM OXIDES WITH BARIUM OXIDE. Lopato, L. M.; Maister, I. M.; Shevchenko, O. V. (Inst. of Problems in Material Management, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 3, 245-8(Mar 1972). (In Ukrainian).

Phase diagrams of the systems Sm_2O_3-BaO and Gd_2O_3-BaO in the concentration range from 0 up to 90 mol. % BaO and within the temperature interval of 1200 to 2400°C were plotted by the method of annealing and tempering as well as by means of the high-temperature differential thermal analysis. It was established that in the studied systems there exist two types of compounds: that of composition 1 : 1 (structure $CaFe_2O_4$) and that of composition 2 : 3 (hexagonal structure). In the systems Eu_2O_3-BaO and Tb_2O_3-BaO the compounds of 1 : 1 and 2 : 3 composition were prepared as well. The effect of barium oxide additives was investigated as applied on the character of temperature change in polymorphous transformations $A \rightleftharpoons H$, $H \rightleftharpoons X$, $B \rightleftharpoons A$ of samarium and gadolinium oxides. (auth)

36523 HOT ISOSTATIC PRESSING OF GLASS-SEALED BeO. Kodaira, K. (Hokkaido Univ., Sapporo); Shimada, M.; Kume, S.; Koizumi, M. Mater. Res. Bull.; 7: No. 6, 551-6(Jun 1972).

Hot isostatic pressing of BeO was performed using a glass as the pressure-transmitting medium in the range 1000 to 1400°C and at 2000 kg/cm^2. Specimens with theoretical density were obtained at relatively low temperature and for shorter pressing time. Their electron fractographs showed intergranular characteristics. Microstructure of the specimens indicated that grains were uniformly distributed and that abnormal grain growth was not recognized, but took place only at higher temperatures under pressure. (auth)

36524 MILLING AND SINTERING OF WC-POWDER. Bengtsson, B. (Chalmers Univ. of Tech., Goteborg); Johannesson, T.; Lindau, L. Planseeber. Pulvermet.; 19: No. 4, 218-27(Dec 1971).

The strains introduced into WC powders during milling have been calculated from the x-ray line broadening, and the sintering behavior of the powders has been studied with a scanning electron microscope. It was found, that the amount of strain, and thus the dislocation density, has no appreciable effect on the sintering together of individual grains. (auth)

36525 EFFECT OF THE ELASTIC ANISOTROPY OF THE MONOCRYSTAL ON THE PROPERTIES OF THE POLYCRYSTALLINE SINTERED MATRIX. Leiber, C. O. Planseeber. Pulvermet.; 19: No. 4, 228-49(Dec 1971). (In German).

For the case of magnesium aluminate, ThO_2, UO_2, UC, TaC, ZrC, MgO, TiC, α-SiC, BeO, TiB_2, and Al_2O_3 it was found that anisotropy of single-crystal Youngs-modulus influences the uppermost density, thermal conductivity, mechanical and elastic properties, hugoniotelastic limit, and thermal stress resistance of the polycrystalline material. It is pointed out that the elastic properties of TiB_2 should be revised. For the case of tellurium, especially its shock resistance, the anisotropy of the elastic compressibility should be considered. (auth)

36526 CS FAMILIES DERIVED FROM THE ReO_3 STRUCTURE TYPE: AN ELECTRON MICROSCOPE STUDY OF REDUCED WO_3 AND RELATED PSEUDOBINARY SYSTEMS. Bursill, L. A.; Hyde, B. G. (Univ. of Western Australia, Nedlands). J. Solid State Chem.; 4: No. 3, 430-46(May 1972).

A broad survey of some ReO_3-related crystallographic shear (CS) structures has been carried out by means of an electron microscopy diffraction study of the systems WO_x and $(W^{6+},M^{5+})O_x$ with M = V, Nb, Ta and $2.90 \le x < 3.00$; MoO_x and $(W,Mo)O_x$; $Nb(O,F)_x$ with $2.75 \le x \le 2.96$; as well as V_2MoO_8. The observations gave a broader view of the field than was previously possible. They revealed the expected "swinging" of the CS planes when the compositions and/or the component ions were varied. They also provided information on the degree of long-range order and the types of defect present. Further light was thrown on the likely mechanism by which the composition changes when a CS structure is reduced or oxidized. These topics are discussed, and an attempt was made to systematize all the observations into a coherent picture incorporating previously available information. This necessitates changing some earlier, dubious conclusions from x-ray diffraction studies. (auth)

Metals and Alloys

Refer also to abstract 36489.

36527 (NP–19318) ANNUAL REPORT, 1971. (National Inst. for Metallurgy, Johannesburg (South Africa)). 36p. Dep. NTIS (U. S. Sales Only).

Topics covered include: analytical chemistry, economics and costing, instruments, minerals and process chemistry, mineralogy, ore dressing, process development, and liaison and information. (M.C.G.)

36528 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. Maerz 1972. Band 6, Heft 3. 165 Referate (Register-Nr.617-928), 103 Referate (Register-Nr.175T-277T). (Plutonium-Documentation. Abstract Journal with Appendix on Transplutonium Elements. March 1972. Vol. 6, No. 3. 165 Abstracts (Register No. 617-928), 103 Abstracts (Register No. 175T-277T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1972). 121p. (In German and English).

Corrosion and Erosion

Refer also to abstracts 35997, 36484, and 36485.

36529 (CONF-720523–1) HIGH-TEMPERATURE OXIDATION OF URANIUM ALLOYS. Cathcart, J. V.; Pawel, R. E.; Petersen, G. F. (Oak Ridge National Lab., Tenn.). 1972. 19p. Dep. NTIS.

From fifth international congress on metallic corrosion meeting; Tokyo, Japan (21 May 1972).

The oxidation characteristics of U–16.6 at. % Nb–5.6 at. % Zr, U–21 at. % Nb, U–15 at. % Zr, and U–18 at. % Mo in the temperature range 700 to 1100°C are discussed. Stresses as large as 10^6 psi develop in the oxide scales on these alloys as oxidation proceeds, and these stresses led to large increases in the lateral dimensions of the specimens. The morphology of the oxide scales is described, and a mechanism of stress generation is suggested. Several stress relief processes, including the plastic deformation of both oxide and metal, are discussed. (auth)

36530 (HW–68035) FLOW TESTING OF BRAZED FUEL ELEMENTS IN ELMO-7. Tverberg, J. C.; Larrick, A. P. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 3 Oct 1960. Contract W-31-109-eng-52. 10p. Dep. NTIS.

Declassified 2 Nov 1971.

Welding appears to be desirable as the final closure for brazed joints in N Reactor fuel elements. The weld may do nothing more than redistribute the braze metal, but in doing so fills voids or pinholes that may permit water entry into the core. Test results show that a weld bead extends the useful life of the fuel element. Heat treatment of the fuel element following brazing had no visible effect on the appearance of the corrosion product or the formation of pinholes. Pinholes visibly appeared within 485 hours on unwelded specimens. Welded specimens appeared completely sound after 800 hours exposure to reactor water conditions. At the end of 1286 hours in Elmo-7, however, the welded brazed closures were covered with a heavy white corrosion product indicating that breakaway corrosion had begun. One element ruptured in the first 152 hours of operation. Water gained access to the core through a pinhole in the braze. The method of rupture was significant. The jacket was sheared on the ruptured end at the braze to uranium interface. Excessive swelling occurred in the heat affected zone. Below the heat affected zone was no swelling. In this region the cladding was perforated with bubbles which were oriented in long, straight lines. At the opposite end swelling again occurred in the heat affected zone. This element was not welded. (auth)

36531 (HW-77602-RD) HYDRIDING AND THERMAL REDISTRIBUTION OF HYDROGEN IN N-REACTOR ZIRCALOY PROCESS TUBES. Shannon, D. W.; Westerman, R. E. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 28 May 1963. Contract [AT(45-1)-1350]. 32p. Dep. NTIS.

Declassified 3 Nov 1971.

Zircaloy-2 corrosion and hydriding data from autoclave and in-reactor capsule experiments have been used to estimate hydriding rates of N-Reactor Zircaloy-2 process tubes. Thermal diffusion calculations show how local concentrations of hydride phase develop. Using the N-reactor temperature calculations for a maximum OD tube temperature of 360°C, the N Reactor process tubes were found to absorb corrosion product hydrogen at a rate up to 21 ppM/year, mostly due to OD corrosion. Lower OD temperatures were considered which result in lower hydriding rates. Hydrogen diffuses towards the inner cool wall and begins to precipitate a hydride "case" at operating conditions in about one to two years of operation at the higher temperatures. Subsequently, the hydride "case" on the inner wall is expected to grow, reaching a thickness of about 6 mils in 20 years, leaving the balance of the tube at 60 to 80 ppM hydrogen. This hydride case formation is due to the radial temperature gradients across the tube wall. Circumferential and longitudinal temperature gradients are shown to have little effect on hydride distribution except in the case of a severe local hot spot. The results emphasize the need for mechanical property studies of N-Reactor Zircaloy-2 process tubes containing a "case" of heavy hydride near the ID surface. (auth)

36532 (HW-79295) AMMONIUM HYDROXIDE FOR pH CONTROL IN PRESSURIZED WATER SYSTEMS. PART I. OUT-OF-REACTOR CORROSION TESTS. Demmitt, T. F.; FitzPatrick, V. F.; Larrick, A. P. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Dec 1963. Contract AT-(45-1)-1350. 21p. Dep. NTIS.

Declassified 3 Nov 1971.

The feasibility of using NH_4OH for pH control in the Hanford N-Reactor was studied. Both in-reactor and out-of-reactor test facilities are being used to determine whether an ammoniated coolant stream at pH 10.1 ± 0.2 will be satisfactory for use in the N-Reactor primary system. The corrosion results obtained during the out-of-reactor tests are presented. (J.R.D.)

36533 (LMEC-71-7) LIQUID METAL ENGINEERING CENTER (LMEC) SEMIANNUAL TECHNICAL PROGRESS REPORT, JANUARY-JUNE 1971. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). 15 Mar 1972. Contract AT(04-3)-700. 206p. Dep. NTIS.

Research progress is reported on precision mechanism operation in liquid sodium, materials compatibility in sodium under FFTF conditions, destructive analysis of Hallam Reactor heat exchangers, pump seal testing, cavitation of valves for sodium loops, and testing of instruments for LMFBR. A program to provide laboratory support for LMEC and LMFBR is described along with operation of Large Components Test Loop, and creep ratchetting tests of LMFBR materials. (J.R.D.)

36534 (SC-T-722507) STRESS-CORROSION CRACKING OF THE U-10 Mo ALLOY. Bedere, Daniele; Nomine, Anne-Marie; Robin, Rene; Miannay, Dominique (Commissariat a l'Energie Atomique, Montrouge (France)). Translated for Sandia Labs., Albuquerque, N. Mex., from French report. 26p. Dep. NTIS.

A study was made on the characteristics of the slow cracking, in air and in water, of a uranium-molybdenum alloy consisting of 10 wt-% of molybdenum. The propagation was discontinuous, and the cracking occurred with divergent or nondivergent branching. The fracture facies also exhibited these characteristics. A hypothesis of embrittlement by hydrogen is advanced. (auth)

36535 (SC-T-722508) MECHANICAL QUANTITIES ASSOCIATED WITH STRESS CORROSION OF THE U-10 Mo ALLOY. Monine, Anne-Marie; Bedere, Daniele; Miannay, Dominique (Commissariat a l'Energie Atomique, Montrougee (France)). Translated for Sandia Labs., Albuquerque, N. Mex., from French report. 33p. Dep. NTIS.

A study was made on the resistance to stress corrosion, in air and at ambient temperature, of a uranium-molybdenum alloy consisting of 10 wt-% of molybdenum. It was found that this resistance is affected by the structural state, loading rate, stress level, and notching factor. (auth)

36536 (SC-T-722510) MECHANICAL STUDY OF THE STRESS CORROSION OF A U-10 Mo ALLOY. Nomine, Anne-Marie; Bedere, Daniele; Robin, Rene; Miannay, Dominique (Commissariat a l'Energie Atomique, Montrouge (France)). Translated for Sandia Labs., Albuquerque, N. Mex., from French report. 28p. Dep. NTIS.

A study was made on the stress-corrosion resistance of a uranium-molybdenum alloy consisting of 10 wt-% of molybdenum in the laboratory atmosphere and in water at ambient temperature. The two states considered, a rough-cast and normalized centered cubic metastable structure, have similar mechanical characteristics. The toughness in these media was found to be the same. Propagation occurred after an incubation period, and its rate was constant. In air the slow cracking was branched and transgranular. In water it was unbranched and mixed. The ultimate fracture was intergranular. The fracture facies examined after fracture are described. (auth)

36537 (Y-1829) ELLIPSOMETRIC STUDY OF THE CORROSION OF URANIUM AND URANIUM-7.5 WEIGHT PERCENT NIOBIUM-2.5 WEIGHT PERCENT ZIRCONIUM ALLOY. Sladky, R. E. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). 20 May 1972. Contract W-7405-eng-26. 45p. Dep. NTIS.

The ellipsometric method was used to study the sputter cleaning and oxidation of uranium and uranium alloy coupons. A calculation was made of the refractive indexes of the metals and their oxides. Corrosion curves were drawn for several different temperatures for film thicknesses up to 4500 Å, and the equations of the curves were determined. A study was made of the effect of tensile stress on the ellipsometric data. (auth)

36538 PROCEEDINGS OF THE FOURTH INTERNATIONAL CONGRESS ON METALLIC CORROSION. Conference Held in Amsterdam, Netherlands, September 7-14, 1969. Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972). 842p. (In English and French). (CONF-690988).

One-hundred-nine papers are included; separate abstracts were prepared for 19. The remaining 90 papers contain information on: mechanical influences on corrosion; high-temperature oxidation; atmospheric corrosion; microstructure and corrosion; passivation and anodic protection; cathodic protection; non-metallic coatings; metallic coatings; and miscellaneous information on materials not in scope for NSA. (P.C.H.)

For abstracts of individual papers see: 36495, 36539-36551, 36590, and 36621-36624.

36539 HOT SALT STRESS CORROSION CRACKING OF TITANIUM ALLOYS. Bakker, D. pp 51-7 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Studies were made on the mechanism of hot salt stress corrosion cracking of IMI Ti-130 (unalloyed Ti), IMI Ti-317 (Ti-5 Al-2.4 Sn), and IMI Ti-318 (Ti-6 Al-4V). The results showed that unalloyed Ti was not susceptible to hot salt cracking; only pitting was observed. The alloys Ti-5 Al-2.5 Sn and Ti-6 Al-4 V were both susceptible to hot salt cracking. Comparative tests showed the great difference between the influence of the load on time-to-fracture (t_f) was substantial. In Ti-6 Al-4 V, t_f was strongly dependent on the load. In Ti-5 Al-2.5 Sn, t_f was independent of the load. Reasons for this are given. (P.C.H.)

36540 STRESS CORROSION CRACKING OF AUSTENITIC STAINLESS STEELS IN HIGH TEMPERATURE WATER. Ito, Goro; Ishihara, Tadao; Shimizu, Yoshihiko (National Research Inst. for Metals, Tokyo). pp 75-82 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam. Netherlands (7 Sep 1969).

The effects of composition and structures of austenitic stainless steels on resistance to stress corrosion cracking were studied in pressurized, high-temperature water containing very low concentrations of chloride. The purpose was to identify the austenitic stainless steels having low susceptibility to stress corrosion cracking in environments of water-cooled reactors, boilers, and/or heat-exchangers. The results showed that alloys containing from 5 to 10% ferrite were susceptible to cracking only in chloride-containing water. Alloys containing less than 5% or from 10 to 40% ferrite were immune to cracking. It was also found that impurities do not cause cracking in alloys containing from 15 to 30% ferrite. (P.C.H.)

36541 ROLE OF YTTRIUM IN THE HIGH TEMPERATURE OXIDATION MECHANISM OF Co–30Cr. Beltran, A. M. (General Electric Co., Schenectady, N. Y.). pp 186-95 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Studies were made on the oxidation behavior of a Co–30 Cr alloy, and the effects and role of Y in the oxidation process. A low concentration level of Y was used (0.15% nominal). The results showed that Co–30 Cr oxidized primarily by the parabolic-rate growth of Cr_2O_3, governed by the diffusion of Cr ions through the oxide via vacancies. Failure of this film at temperature resulted in nearly linear-rate oxidation of the Cr-poor substrate, resulting in the formation of nodules comprised of Cr_2O_3, $CoCr_2O_4$, and CoO. Nodule growth was then apparently rate-dependent on the alternate processes of Cr_2O_3 formation and failure at the interface. Overall weight gain behavior, therefore, was a combination of the two modes producing a positive deviation from parabolic kinetics. The addition of nominally 0.1 wt % Y significantly reduced oxidation kinetics to cubic rate behavior and improved scale adherence up to 1100°C. Yttrium's role, besides preventing the formation of nodules, involved in situ internal oxidation, with subsequent build-up of a sub-surface grain boundary network in advance of the oxide-metal interface. This acted to reduce the rate of Cr supplied to the surface and as a sink for vacancies, accounting for reduced kinetics and scale adherence, respectively. (P.C.H.)

36542 ISOTHERMAL STEAM CORROSION OF COMMERCIAL GRADE AUSTENITIC STAINLESS STEELS AND NICKEL BASE ALLOYS IN TWO TECHNICAL SURFACE CONDITIONS. Leistikow, Siegfried (Kernforschungszentrum, Karlsruhe, Ger.). pp 278-90 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

The results of isothermal, semidynamic loop experiments in superheated steam under atmospheric pressure, in which austenitic stainless steels and nickel-base alloys of two technical surface conditions have been used, are reported. In 5000 h experiments in superheated steam (620°C, 1 atm, 2 to 4 cm/sec and 6 ± 2 ppM O_2) sheet specimens of commercial grade materials suitable for application in superheated steam differed in their extent of general corrosion, dependent on their chemical composition. Among the groups of austenitic stainless steels and of Hastelloy and Inconel alloys, corrosion resistance increased with increasing Ni, Mo, and Nb content, while it decreased with increasing Fe content. Ground sheet specimens behaved uniformly well under the experimental conditions due to the equal contents of less noble elements activated by cold working and selective oxide formation. Corrosion of cold worked specimens of the Incoloy 800 in oxygen-containing superheated steam developed an extremely thin oxide layer whose thickness was constant during the experimental period. Corrosion mechanisms are discussed. (P.C.H.)

36543 ANALYSIS OF THE OXIDE SCALE ON THREE STAINLESS STEELS OXIDIZED IN STEAM AT 800 C. Ericsson, Torsten (Aktiebolaget Atomenergi, Stockholm). pp 306-19 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

On ground specimens of 18 Cr–11 Ni, 19 Cr–25 Ni, and 19 Cr–35 Ni steels oxidized in steam at 800°C a Cr_2O_3 layer with uniform thickness was first formed, growing at about the same rate on all three steels. Subsequently an Fe and Ni-rich spinel layer was formed outside the CrO_3 layer on 18/11 and 19/35. Nodules nucleated at mechanical flaws in the Cr_2O_3 layer. The outer layer of a nodule grew by cation diffusion outwards and the inner layer by oxygen diffusion inwards, giving internal oxidation. The internal oxide particles of chromite were stable enough to prevent Cr from entering the outer nodule layer at 800°C. In the parts of the inner layer of a nodule where the oxygen activity was high enough, Ni ferrite or NiO, depending on the Ni content of the steel, was formed between the chromite particles. Like Cr, Mn was almost completely oxidized in the precipitation front. Mn was probably bound in oxide particles distinct from the chromite particles and was not as stable as they were. Therefore, Mn can diffuse to the outer layer. The growth of the nodule was eventually stopped by a healing Cr_2O_3 layer developed in contact with the alloy. The healing layer in nodules on 18/11 can be broken through. The formation of a healing Cr_2O_3 layer was facilitated by a high rate of Cr diffusion in an alloy. This may explain the decrease in oxidation rate going from an Fe 18 Cr–15 Ni alloy to an Fe 18 Cr–35 Ni alloy. (auth)

36544 OXIDATION OF METALS AND ALLOYS FOR CLADDING OF FAST REACTOR FUEL ELEMENTS BY OXYGEN-CONTAINING LIQUID SODIUM. Borgstedt, Hans U.; Frees, Guenter (Kernforschungszentrum, Karlsruhe, Ger.). pp 325-30 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

The corrosion behavior of austenitic stainless steels and unconventional V alloys was studied in a sodium test loop. Among the sodium loop conditions, the oxygen content of the liquid sodium appeared to be the most important parameter. After an initial period of corrosion reactions, the stainless steels suffered composition changes in the surface layers. Studies on V-base–Ti alloys showed that the oxygen uptake and the degree of embrittlement was dependent on the Ti content of the alloys. Substitution of Ti by Zr resulted in alloys that were less sensitive to oxygen embrittlement. Different rate laws for the alloy V–1 Ti–15 Cr were measured as a function of the O content of Na. In high purity sodium, the rate law was parabolic, at higher oxygen contents, slightly linear weight losses were found, and at oxygen concentrations higher than 5 ppM, the reaction was severely linear. Analysis of the corrosion behavior of different V alloys led to the conclusion that only V–Cr alloys with low concentrations of the scavenger elements Zr or Ti may have properties that make them suitable as cladding materials in a sodium-cooled reactor. However, both stainless steel and V alloy claddings are sensitive to embrittlement by interstitial elements. (P.C.H.)

36545 HIGH TEMPERATURE OXIDATION OF TANTALUM-BASE ALLOYS. Stringer, J.; Dooley, R. B. (Univ. of Liverpool). pp 346-53 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Studies were made on the effects of Nb and W alloying elements on the stability of the suboxide plates and the effects on the scale plasticity in the high-temperature oxidation of Ta-base alloys. No evidence was found for diminished suboxide stability in Nb–Ta-base alloys. Microprobe analysis showed that the Nb/Ta ratio was the same in the pentoxide, the suboxide, and the metal. If anything, the platelets appeared more stable than in pure Ta. However, the porosity was much reduced; this was almost certainly due to an increase in scale plasticity, but the habit-selection of the platelets may also be a factor: the cause for this is not understood. There was also little evidence that W modified suboxide stability, but it clearly produced an effect resulting in the rapid oxidation of the once-formed plates. Also there was no evidence that W modified the plasticity of the scale. The most significant effect from a technical point of view was the rapid grain boundary embrittlement of recrystallized specimens. (P.C.H.)

36546 ATMOSPHERIC CORROSION BEHAVIOR OF STAINLESS STEELS AND NICKEL ALLOYS. Evans, T. E. (International Nickel Ltd., London). pp 408-18 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Ten-year atmospheric corrosion tests were carried out at Birmingham, England on eleven commercial grades of stainless steel, nickel, and twelve nickel alloys. Similar tests were performed for periods varying from two to three years on four grades of stainless steel at fourteen different test sites in five different countries, viz U.K., France, West Germany, Australia, and South Africa, encompassing a variety of atmospheric exposure conditions. Of the stainless steels, molybdenum-bearing chromium-nickel grades, e.g. Type 316, 18Cr/10Ni/1.3Mo, remained virtually unaffected unless exposed to sea spray or, in one instance, to heavy local pollution from industrial plants. Chromium-nickel steel without added Mo, e.g. Type 304, usually showed some corrosion in marine and industrial environments, although often satisfactory in urban and suburban atmospheres. Chromium steels without added Ni or Mo, e.g. Type 430, rusted at all sites except one, although the extent of corrosion varied according to the environment. In some instances, materials with No. 3 finish (dull polished) and electropolished finish performed better than similar steel with 2B finish. With Type 304 steel periodic cleaning with a detergent solution and soft brush produced an improvement which generally persisted afterwards, but this treatment was less effective on Type 430 steel. Comparison of results from different sites bearing nominally similar descriptions, e.g. marine, industrial, often indicated large differences in the extent of corrosion of a particular steel, due, probably to factors such as the degree of exposure to sea spray, nature, and proximity of sources of local pollution and climatological features. Nickel and nickel alloys formed layers of corrosion product which completely covered the surface of the metal. Of the materials tested, nickel–chromium–iron alloys suffered the least corrosion, followed by high-nickel and nickel–copper alloys, cupro-nickels and nickel–molybdenum alloys and lastly, nickel–iron alloys. (auth)

36547 CORROSION OF METALS BY ORGANIC ACID VAPORS. Donovan, P. D.; Stringer, J. (Royal Armament Research and Development Establishment, Ft. Halstead, Eng.). pp 537-44 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

The corrosivity of various organic materials is discussed, and studies on the susceptibility of metals and steels to attack by formic and acetic acids are reported. The results showed that in general acetic acid vapors were more corrosive than formic acid vapors. With Mg, Pb, and Cd this effect was particularly pronounced. The rates of corrosion of Zn, Cd, and steel in atmospheres containing formaldehyde and propionic and butyric acids were also studied. The corrosion of Cd by propionic and butyric acids explained the ready susceptibility to corrosion of Cd by vapors from freshly-applied drying-oil paints. Corrosion of Zn by formaldehyde suggested that Zn presents a suitable catalytic surface for oxidation of formaldehyde to formic acid. A number of Cd, Zn, and Mn alloy electrodeposits were also examined for their susceptibility to corrosion in acetic acid-containing atmospheres. All coatings appeared to protect sacrificially and corrosion of the basic steel started only when they were almost completely corroded away. It was also found that acetic acid vapors attack Sn and Fe more rapidly than those of formic acid, formic acid vapors produced a more aggressive attack on Sn-coated steel. (P.C.H.)

36548 OXIDATION OF Ni–20Cr ALLOY AND STAINLESS STEELS IN PRESENCE OF CHLORIDES. Seybolt, A. U. (General Electric Co., Schenectady, N. Y.). pp 560-70 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Metallographic and electron probe data are presented in an attempt to explain the mechanism of a form of high-temperature oxidation which occurs in Ni–20Cr alloys and in a wide range of Fe–Cr–Ni alloys of about 20 Cr, when the oxidation process occurs using a large excess of NaCl–KCl. In the Ni–20Cr alloys, Cr_2O_3 is formed at the surface in a nonadherent granular form which forces a countercurrent flow of vacancies into the structure since the nickel-rich porous alloy does not sinter appreciably. On the contrary, voids generated by the migration outward of chromium are filled with the liquid salt, thus setting up a continuous loss of chromium through the void-salt network all the way to the alloy/salt interface. It is shown that this process requires very rapid diffusion of chromium from the alloy to the void-salt system, much faster than occurs during bulk diffusion. There is metallographic and electron probe evidence that this short-circuiting chromium diffusion is grain boundary diffusion and that continued chromium removal in the porous zone required extensive recrystallization in the porous zone. The origin of this recrystallized region has not been established. The morphology of attack in the Ni–20Cr alloys is affected by ambient oxygen pressure and it is suggested that high (1 atm) oxygen pressures during the corrosion process cause "excess" oxygen diffusion down existing grain boundaries where excess oxygen renders the chromium less mobile. The corrosion process in the stainless steel alloys is basically the same as just outlined for the Ni–20Cr alloys. In addition, there is the complication of the effect of carbon (which was not studied in Ni–20Cr) and the effect of Fe/Ni ratio. Evidence is presented which suggests that both oxygen and carbon can anchor chromium at grain boundaries and thus minimize external loss of chromium via grain boundaries to the corroding medium. (P.C.H.)

36549 EFFECT OF CATHODIC ALLOYING OF ALLOYS ON THEIR PASSIVATION AND CORROSION PROCESSES. Tomashov, N. D.; Chernova, G. P.; Modestova, V. N.; (and others) (Inst. of Physical Chemistry, Moscow). pp 642-50 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Corrosion and self passivation of titanium and stainless steels (25% Cr and 25% Cr–6% Ni) when alloyed with Pd (0.2 to 1%) in the acid solutions (H_2SO_4, HCl) have been investigated. It was found that during active dissolution of titanium or stainless steel, palladium accumulation occurred on the surface as separate, discrete palladium crystallites. Palladium accumulation took place partly in an effective form (having a good contact with the surface and contributing to the alloy passivation) and partly in an ineffective form (having bad contact with the surface and affecting the alloy passivation slightly). On Ti–0.2 Pd and Ti–0.86 Pd alloys, the kinetics of the effective and ineffective palladium accumulation during the self passivation in 40 percent sulfuric acid solutions were studied. It was found that passivation of the titanium–palladium alloy occurs when the surface of the effective palladium is small (about 0.1 cm^2). Palladium accumulating on the surface of titanium during its active dissolution is hydrogen penetrated. The extent of hydrogen penetration is inversely proportional to the amount of Pd in the alloy and proportional to the time the alloy is in the active state. In concentrated sulfuric acid (80% H_2SO_4, 60°C), in contrast to more dilute solutions, the accumulation of palladium on the surface of titanium containing palladium took place as PdS. It was established that the self passivation of titanium–palladium alloys occurs with more difficulty in large volumes of corrosive solution or when it is renewed as well as in the absence of oxygen (in inert atmospheres of N_2 and Ar). This effect was associated with diminishing accumulation of Ti^{4+} ions (as TiO^{2+}) at the expense of the interaction of Ti^{3+} ions with oxygen. It was also found that palladium additions to titanium as well as to some of its alloys (e.g., Ti–Mo), decrease the extent of their hydrogen penetration when etched in acids or under cathodic polarization. (P.C.H.)

36550 ELECTROCHEMICAL STUDIES ON THE PASSIVE FILM OF TANTALUM. Otsuka, Rikuro; Uda, Masayuki (Inst. of Physical and Chemical Research, Yamato, Japan). pp 659-62 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Attempts were made through experiments to reveal the nature of the film formed in the initial stage of passivation. As a representative of passive metals, Ta specimens were used. The anodic polarization behavior of the metal was investigated in aqueous solutions of H_2SO_4 and NaOH in order to obtain some information about the passive film. From the results it was concluded that in the initial stage of passivation, the charged particle penetrating the passive film is certainly an electron and that the passive film grows as a result of the penetration of electrons. This conclusion supports the adsorption theory of the two points of view regarding the nature of the passive film. (P.C.H.)

36551 MEASUREMENT OF VERY LOW CORROSION RATES IN CLOSED SYSTEMS. Aladjem, Abraham; Roy, Aharon S.; Yahalom, J. (Soreq Nuclear Research Center, Yavne, Israel). pp 810-11 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

A tracer technique free of the usual disadvantages is described for determining either overall corrosion rates or the kinetics of their change for many metals and corrosive media. The finished metal samples are irradiated with neutrons just before the corrosion test. The corrosion rate of the metal in contact with a solution is then determined either by continuous monitoring or the increase in the activity of the solution (the counting probe is immersed in the solution at a certain distance from the irradiated sample in order to avoid an increase in background count), or by periodic measurement of the activity of aliquots withdrawn from the solution. The second method was much more sensitive since counter setups with much lower background could be used and in some cases the specific activity of the sample could be increased markedly by evaporation. The two examples described are for the corrosion of Ta and brass. This method brings the sensitivity of corrosion testing to the ppM or ppB level of determination of corrosion products in the corrosive medium. (P.C.H.)

36552 POTENTIALS OF MOLYBDENUM AND TUNGSTEN ELECTRODES IN SOLUTIONS OF HYDROGEN PEROXIDE. Ganiev, Sh. U.; Artykbaev, T. D.; Tsyganov, G. A. (Inst. of Chemistry, Tashkent). Uzb. Khim. Zh.; No. 6, 6-7(1971). (In Russian).

Metallic Mo and W readily dissolve in H_2O_2, forming the corresponding peroxides. This chemical behavior was further characterized by measurements of the potentials of Mo and W in solutions of H_2O_2 over a wide range of pH. The chemical inertia of oxides which are formed on electrode surfaces with the assistance of H_2O_2 is considerably greater than without it. (K.S.W.)

36553 VARIATION OF CONCENTRATION WITH DEPTH OF ABSORBED OXYGEN IN NIOBIUM DURING OXIDATION. Bellina, J. J. Jr.; Lederich, R. J.; O'Neal, J. E. (McDonnell Douglas Corp., St. Louis). J. Appl. Phys.; 43: No. 2, 287-92(Feb 1972).

The dissolution of oxygen in niobium is governed by Fick's second law applied with the appropriate boundary conditions. Two different boundary conditions have been proposed to describe the physical situation: (i) That the surface concentration of oxygen atoms is constant; and (ii) that the flux of oxygen into the metal is directly proportional to the difference between the actual concentration on the surface at any time and the concentration which would be in equilibrium with the partial pressure of the oxygen. The absorption of oxygen in (001) niobium at temperatures of 450 – 650°C and pressures of 3×10^{-6} to 3×10^{-4} torr O_2 was measured using ellipsometry. The results indicate that for the pressure and temperature ranges investigated, the latter boundary condition is the appropriate one. (auth)

36554 AUTORADIOGRAPHIC ANALYSIS OF MICROSEGREGATION OF HYDROGEN IN METALS. Louthan, M. R. Jr.; Rawl, D. E. Jr.; Huntoon, R. T. (E. I. du Pont de Nemours and Co., Savannah River, S. C.). Contract AT(07-2)-1. Corrosion; 28: No. 5, 172-6(May 1972).

In autoradiographic studies of tritium distribution in multiphase alloys, both the tritium within the metal and the emanated tritium contribute to darkening of the autoradiographic emulsion; and unless both are considered, erroneous conclusions about tritium segregation may be reached. (auth)

36555 EFFECT OF INITIAL HYDROGEN CONTENT OF A TITANIUM ALLOY ON SUSCEPTIBILITY TO HOT SALT STRESS CORROSION. Gray, Hugh R. (Lewis Research Center, Cleveland). Corrosion; 28: No. 5, 186-8(May 1972).

The influence of the initial hydrogen content of a titanium alloy on subsequent resistance to hot salt stress corrosion embrittlement and cracking was investigated. A Ti-8Al-1Mo-1V alloy was tested in four conditions: mill annealed (70 ppM H), duplex annealed (70 ppM H), vacuum annealed to an intermediate (36 ppM H) and a low (9 ppM H) hydrogen level. Material annealed at 650°C (duplex condition) exhibited resistance to hot salt stress corrosion superior to that exhibited by material in the mill annealed condition. Reduction of the alloy hydrogen content from 70 to as low as 9 ppM did not influence resistance to hot salt stress corrosion embrittlement or cracking. (auth)

36556 SCC OF Ti–6Al–4V FOIL BY METHANOL. EFFECT OF TREATMENTS WITH 2,4-PENTANEDIONE AND ITS METAL COMPLEXES. Haney, E. G.; Fugassi, Paul (Carnegie-Mellon Univ., Pittsburgh). Corrosion; 28: No. 5, 189-91(May 1972).

The susceptibility of Ti-6Al-4V foil to stress corrosion cracking (SCC) by methanol can be decreased by treatment of the foil with 2,4-pentanedione prior to its immersion in the corroding media. It is assumed that such treatments remove from the protective film formed on the foil by exposure to the atmosphere, certain metal ions whose oxides are more readily penetrated by the ions, Na^+ and Cl^- or Fe^{+3} and Cl^-, present in the corroding media. (auth)

36557 STUDY OF THE INTERGRANULAR CRACKING OF U–7.5 WT. PERCENT Nb–2.5 WT. PERCENT Zr (MULBERRY) ALLOY IN AQUEOUS CHLORIDE SOLUTIONS. Zehr, Stanley W. (Sandia Labs., Livermore, Calif.). Contract AT(29-1)-789. Corrosion; 28: No. 5, 196-205(May 1972).

A qualitative study was made of the electrochemical processes and chemical species involved in the intergranular stress corrosion cracking (SCC) of U – 7.5 wt % Nb – 2.5 wt % Zr (Mulberry) alloy in aqueous Cl^- environments. Optical microscopy, pH analysis, electron microprobe analysis, and Auger spectroscopy were used to examine the SCC behavior of simple bend specimens. It was found that in the absence of reducible cations, crack initiation is preceded by an incubation period during which a differential aeration cell is established. Crack propagation is believed to proceed by alternation of anodic dissolution and brittle fracture processes at the crack tip. Hydrogen evolution from within the crack was observed during propagation and is believed to indicate that reduction of H^+ ions to $H_{2(g)}$ is the rate-controlling cathodic process during crack propagation. Observed enrichment of Nb at the fracture faces is believed to indicate a preferential dissolution of U and Zr, leaving Nb-rich oxide, a phenomenon consistent with the Pourbaix diagrams for these elements. (auth)

36558 CORROSION OF PRESTRESSING WIRES OF CONCRETE PRESSURE VESSELS. Hollingum, P. J. (British Engine, Manchester, Eng.). Anti-Corros. Methods Mater.; 19: No. 4, 4-7(Apr 1972).

A case is reported of corrosion of the prestressing tendons of two concrete reactor pressure vessels. The tendons, consisting of 0.6% C steel wires, greased, and installed in mild corrugated ducts, were stored in the bottom cap of the pressure vessels. After about 6 months substantial pitting corrosion was found. A summary is given of the manufacture, storage conditions, and examination of the tendons. Laboratory and site investigations to determine the causes of corrosion are described. (UK)

Preparation and Fabrication

36559 (BDX–613-637) BENDIX KANSAS CITY ELECTRICAL TERMINATION WELDING HANDBOOK. Thoeni, Kent; Stittsworth, Dennis; Hollar, Don; Hefley, Steve; Chandler, Gene; Pressly, Bruce (Bendix Corp., Kansas City, Mo.). May 1972. Contract AT(29-1)-613. 47p. Dep. NTIS.

A welding handbook is presented which describes the welding processes and material combinations used at Bendix to weld electrical terminations. There are four production welding processes being used at Bendix for electrical terminations. These welding processes are opposed-electrode, parallel-gap, percussive-arc, and pulse-arc. The principles of each process are briefly described. Following the text are appropriate tables and figures detailing the material combinations and configurations which have been welded in production at Bendix. (J.R.D.)

36560 (BNWL-MA–64) BNW MANUAL FOR DESIGN AND CONSTRUCTION OF SYSTEMS AND EQUIPMENT CONTAINING LIQUID ALKALI METAL. Thiede, R. A. [Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.]. 23 Jun 1969. 77p. Dep. NTIS.

A manual is presented which applies to the design, construction and repair of liquid alkali metal systems and equipment; the manual also applies to new construction or new repairs to existing equipment. This manual supersedes BNWL-MA-21 for liquid metal systems. (J.R.D.)

36561 (CEA-R–4291) STUDY OF A HIGH MECHANICAL RESISTANCE U ALLOY CONTAINING 7.5 PERCENT Nb AND 2.5 PERCENT Zr (BY WEIGHT). Choquet, Philippe (Commissariat a l'Energie Atomique, Valduc (France). Centre d'Etudes). Apr 1972. 135p. (In French). Dep. NTIS (U. S. Sales Only).

A method of manufacturing U alloy ingots containing 7.5 percent Nb and 2.5 percent Zr (by weight) using an induction furnace was developed. The crucible and the mold were made using a plasma torch to melt the calcium zirconate and zirconium powders. In the crucible, the load was maintained well agitated for 45 minutes between 1550 and 1650°C. Casting was carried out at 1600°C. The solidification must be directed for the best results to be obtained with a 1000°C thermal gradient in the mold, the top of the mold being at 1400°C. Some attempts were made at refusion using an electron bombardment furnace, but the results have still to be verified. Mechanical trials on test rods of the ingot material were conducted after homogeneization at 1000°C for 8 hours and after the following treatments: quenching in water; quenching in oil; and quenching in water after tempering up to 350°C. Rupture loads were between 80 and 165 daNewtons/mm^2, elastic limits of 0.2 percent were between 40 and 150 daNewtons/mm^2 and elongations were between 23 and 0.5 percent. (auth)

36562 (GA–5918(Pt.2)) ADVANCED, GRAPHITE-MATRIX DISPERSION TYPE FUEL SYSTEMS AND RESEARCH ON GRAPHITE. Quarterly Progress Report for the Period Ending November 14, 1964. Bokros, J. C.; Goeddel, W. V.; Norman, R. E.; Sandefur, N. L.; White, J. L. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). 15 Nov 1964. Contract AT-(04-3)-167. 9p. Dep. NTIS.

Declassified 27 Oct 1971.

Results of investigations of rates and mechanisms of U and Th migration through pyrolytic carbon coatings are described.

Development of hot working processes for carbide fuels is summarized. (J.R.D.)

36563 (HW–64889) UNBONDED CLOSURE WELDING PROCESS. Correy, Thomas B. Sr. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 22 Apr 1960. Contract [AT(45-1)-1350]. 6p. Dep. NTIS.
Declassified 2 Nov 1971.

An unbonded closure with reactor-grade corrosion-resistant welds can be produced using a 0.060-inch thick Zircaloy-2 insert ring fusion welded by the tungsten inert gas process using argon shielding gas. The welds are made with direct current straight polarity in a small simple atmospheric pressure chamber that is continuously purged with argon gas. Approximately 200 pieces have been welded and given the high pressure and temperature autoclave test producing a lustrous black oxide coating of reactor grade. There has been no evidence of discoloration or corrosion products on the weld or in the weld zone. (auth)

36564 (HW–66675) PREDICTED Z PLANT RADIATION EXPOSURE LEVELS VS PLUTONIUM ISOTOPIC CONCENTRATION OF PRODUCTS. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 19 Aug 1960. Contract AT(45-1)-1350. 8p. Dep. NTIS.
Declassified 3 Nov 1971.

Seven charts show the anticipated relationship between whole-body exposure levels encountered in Z plant vs the plutonium isotopic concentration of the product. The anticipated effect of ¼ in. x-ray and 1-in. high-density shielding glass and radiation experience associated with casting, machining, inspection, and Recuplex operation are given. (M.C.G.)

36565 (HW–67438) SURVEY OF BRAZING ALLOYS FOR NPR FUEL ELEMENTS. Tverberg, J. C.; Smith, E. A. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 20 Sep 1960. Contract AT(45-1)-1350. 18p. Dep. NTIS.
Declassified 5 Nov 1971.

Results of an inquiry at research sites concerning investigations of brazing alloys for N-Reactor fuel elements are presented. A number of promising braze alloys were suggested. Plans for further research on these alloys are summarized. (J.R.D.)

36566 (HW–75088) DIMENSIONAL VARIATIONS OF ZIRCALOY CLAD COEXTRUDED ON URANIUM FOR N-REACTOR FUEL. Interim Report. Knecht, R. L. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Aug 1962. Contract AT(45-1)-1350. 36p. Dep. NTIS.
Declassified 2 Nov 1971.

The common variations in clad dimensions on N-Reactor fuel are described. Studies to determine the causes and possible corrective actions to prevent these variations are also described. (J.R.D.)

36567 (HW–83929) DEVELOPMENT OF THE HOT-HEADED, PROJECTION WELDED, AND BRAZED END CLOSURE. Brown, W. F.; Ard, P. A.; Minor, J. E. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 31 Aug 1964. Contract AT(45-1)-1350. 49p. Dep. NTIS.
Declassified 2 Nov 1971.

The hot-headed, projection welded and brazed closure was developed from a previously investigated alternate closure called the "Hot-Head Closure Process." In this process the ends of the fuel were back extruded to flow the OD and ID cladding back over the major portion of the fuel ends. The ends were then machined flat and a Zircaloy-2 ring was projection welded to the fuel element to complete the closure. This closure performed well in small scale irradiation tests; produced no metallurgical damage to the fuel, cladding, or bond between the fuel and cladding; and eliminated many of the tolerance problems with bonding a ring into a recessed fuel tube. However, this closure did not provide a continuous metallurgical bond across the interface between the fuel element and the end cap and left small crevices around the OD and ID at the junction of the fuel element and the end cap which were difficult to clean thus increasing the probability of corrosion in the crevices. Improvement of the previously developed "back extrusion" technique to eliminate the rounded shoulders which cause the crevice at the junction of the fuel element and the closure cap is described. Results of investigation of end cap designs which would permit encapsulation of the preplaced copper braze materials with intimate contact at the interface areas without contaminating the projection weld are reported along with development of placement techniques for the braze material, design and construction of tools and fixtures, and determination of welding and postheating conditions. The end closure application described was limited to the inner fuel component. To apply these closure techniques to the outer fuel component would require resistance welding equipment with a larger electrical capacity than the 600 kVA, three phase machine currently available. (auth)

36568 (ORNL-TM–3764) PROGRESS REPORT ON PROGRAM ENTITLED "AUTOMATED WELDER FOR NUCLEAR PIPE CONSTRUCTION" (189a 10557 FOR PERIOD ENDING DECEMBER 31, 1971). Holz, P. P.; Slaughter, G. M.; Moore, R. L. (Oak Ridge National Lab., Tenn.). 29 Mar 1972. 19p. Dep. NTIS.

Development work on suitable equipment, welding procedures, and programmed controls to produce butt welds in pipes from 3 to 30 inches in diameter with the consistent high quality required for nuclear reactor systems is described. The advent of new commercial suppliers of automated welding equipment is discussed. Development of carriages for pipe sizes greater than 16 inches in diameter has been discontinued, based on the possibility of substituting newly developed, commercially available systems for applications involving the larger sizes. Four automated welding systems were shipped to construction sites where first operational reports indicate favorable progress. Procedure development was completed for 3- and 6- in. stainless steel pipe and for 6- and 12- in. carbon steel pipe. Guidelines were established to weld 12- and 16-in. stainless steel pipe. (auth)

36569 (RDT-M–1-2-T(4-72)) STAINLESS STEEL WELDING RODS AND BARE ELECTRODES (ASME SFA-5.9 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1972. 12p. RSO.

A standard prescribing requirements for stainless steel welding rods and bare electrodes (ASME SFA–5.9 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

36570 (RDT-M–2-4-T(4-72)) ALLOY STEEL FORGINGS (ASME SA-336 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1972. 9p. RSO.

A standard prescribing requirements for alloy steel forgings (ASME SA-336 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-4T, dated July 1971. (J.R.D.)

36571 (RDT-M–3-31-T(4-72)) STAINLESS STEEL CENTRIFUGALLY CAST PIPE (ASME SA-451 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1972. 11p. RSO.

A standard prescribing requirements for stainless steel centrifugally cast pipe (ASME SA–451 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

36572 (RDT-M–6-1-T(4-72)) ALLOY STEEL BOLTING MATERIAL FOR LOW TEMPERATURE SERVICE (ASME SA-320 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1972. 9p. RSO.

A standard prescribing requirements for alloy steel bolting materials for low-temperature service (ASME SA–320 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT 6–1T dated July 1971. (J.R.D.)

36573 (RDT-M–6-6-T(4-72)) HIGH-STRENGTH, HIGH-TEMPERATURE BOLTING MATERIALS (ASME SA-453 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1972. 9p. RSO.

A standard prescribing requirements for high-strength, high-temperature bolting materials (ASME SA–453 with additional requirements) for nuclear and associated applications is presented. (J.R.D.)

36574 HOT-PRESSING OF BERYLLIA. Shimohira, Takajiro (National Inst. for Researches in Inorganic Materials, Tokyo). Yogyo Kyokai Shi; 80: No. 1, 25-30(Jan 1972). (In Japanese).

Experimental data on the densification rate of BeO compacts, hot-pressed in graphite dies for 1275 to 1700°C and for 115 and 289 kg/cm^2, showed that the densification rate during final stage is described by; $d\rho/dt = 10\ \sigma_a D\Omega/R^2kT\rho^{1/2}$, which has been derived by combining the effective stress with the Nabarro–Herring microcreep in a previous study. Plots of the densification rate vs ρ^{-} were fitted well with two straight lines; the lower slopes represented the final stage of densification which were predicted by this theoretical equation, the higher slopes suggest diffusional transport of materials based on grain-boundary diffusion and/or grain-boundary sliding. Although the densification is justified by the linear relationship in $\rho^{2/3}$ vs t and $-\ln(1-\rho)$ vs t, it can also predict a time necessary for the compact to be theoretical density and gives a reasonable conclusion. A nonlinear relationship between $d\rho/dt$ and $\rho^{-1/3}$ prevailed at lower temperatures, which suggests that the densification is contributed by certain slip mode, as a basal slip, concurrent with a pore structure variation. (auth) (Japan)

36575 HIGH STRENGTH SINTERED FERROUS BASE POWDER ALLOYS. (to Amsted Industries Inc.). British Patent 1,272,847. 3 May 1972. Priority date 2 Aug 1968, United States.

A method is described for the preparation of high-strength sintered ferrous-base powder alloys. The alloy has the composition Ni-16 to 20%, Co-7 to 11%, Mo-4 to 6%, Ti-0.3 to 0.5%, Al-0.05 to 0.15%, and balance Fe. The alloy is produced by mixing proportions of powdered constituents in a manner to achieve a substantially homogeneous, statistically random non-agglomerated mass, compacting the powders into a coherent mass, sintering the mass in a protective atmosphere, and quenching the mass to achieve a martensitic phase substantially free of internal stresses. The resultant alloys have good hardness and tensile strength after heat treatment. (P.C.H.)

36576 ELECTROTRANSPORT PURIFICATION AND SOME CHARACTERIZATION STUDIES OF VANADIUM METAL. Carlson, O. N.; Schmidt, F. A.; Alexander, D. G. (Iowa State Univ., Ames). Met. Trans.; 3: No. 5, 1249-54(May 1972).

High-purity vanadium metal having an interstitial impurity content of <5 wt ppM and a resistance ratio, $R_{300\ K}/R_{4.2\ K}$, of >1880 has been prepared by an electrotransport technique. The lattice parameter of vanadium of this purity is 3.0269 ± 3Å. An extrapolated value for the room temperature resolved flow stress of vanadium free of C, O, and N was determined to be 0.41 kg/mm² on this material. (auth)

36577 ELECTRON BEAM FLOAT ZONE GROWTH OF NIOBIUM–TANTALUM ALLOY CRYSTALS. Rubin, J. J.; Malm, D. L.; Bachmann, K. J. (Bell Telephone Labs., Murray Hill, N. J.). Mater. Res. Bull.; 7: No. 6, 597-602(Jun 1972).

The growth of seeded crystals of $Nb_{(1-x)}Ta_x$ of composition $0 < x < .25$ by electron-beam float zoning is described. The purity of these crystals was characterized on the basis of spark source mass-spectrometric analysis. (auth)

36578 TANTALUM FILMS TRIODE-SPUTTERED IN MIXTURES OF ARGON AND WATER VAPOR. Westwood, W. D.; Willmott, D. J.; Wilcox, P. S. (Bell-Northern Research, Ottawa). J. Vac. Sci. Technol.; 9: No. 2, 987-90(Mar-Apr 1972). (CONF-711045–1).

From fifth international vacuum congress; Boston, Mass. (11 Oct 1971).

Tantalum films have been deposited in a triode sputtering system operating at a total pressure of 5×10^{-4} torr that was maintained by continuously adding an argon –water vapor mixture. Because of the low operating pressure, a mass spectrometer mounted directly in the chamber was used, without any differential pumping, to monitor mass spectra before, during, and after sputtering. The mass spectra show that the water vapor is dissociated in the discharge, and the resultant oxygen is gettered into the film. The oxygen content of the films was determined from the anodization efficiency, and it increased linearly with the inlet rate of water vapor. Measurements of the electrical properties show that the oxygen is incorporated in the films in the same way for water vapor and oxygen doping. The resistivity is increased from 50 to 10^{14} $\mu\Omega$ cm with increasing oxygen content. The rapid increase in resistivity from 50 to 200 $\mu\Omega$ cm between 4 and 11 at. % is due to the change from bcc to the β-Ta structure. These results show that very low outgassing rates of water vapor may be sufficient to produce β-Ta in many sputtering systems. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 35838, 36009, 36310, 37782, 37783, 37786, and 37823.

36579 (COO–1198-821) MATRIX BEHAVIOR IN COPPER–TUNGSTEN COMPOSITES AT SMALL STRAINS. Chawla, Krishan Kumar (Illinois Univ., Urbana). Jun 1971. Contract AT-(11-1)-1198. 94p. Dep. NTIS.

Thesis.

The matrix deformation behavior and its dislocation structure were examined in the composites consisting of a single-crystal copper matrix with a small number of tungsten wires embedded in it. Dislocation etch-pit observations on the matrix showed a zone of very high dislocation density (>10^8 cm^{-2}) near the fibers which leveled off with distance from the interface. The dislocation density in regions far away from the fiber increased with the fiber volume fraction. The initial matrix structure was discussed on the basis of the stresses induced in the soft matrix due to the differential shrinkage between the fiber and the matrix during fabrication. The matrix stress-strain curves as derived from the composite curves on the assumption of elastic fibers showed higher micro-yield stresses and higher strain-hardening rates than the unreinforced copper crystals. This was explained in terms of the dislocation density and distribution in the deformed state. The preexisting cell walls thickened on deformation and an estimate of the dislocation mean free path indicated that it was of the order of the cell diameter. The high strain-hardening rates were thought to be due to these cell wall obstacles and not due to the fiber-matrix interaction during straining. The inelastic recovered strain obtained on unloading was found to increase after a little strain rather rapidly with strain for composites. This was explained in terms of strong restoring force from the cell wall obstacles. Thus, the fiber-matrix interaction during the fabrication and the consequent structure of the matrix were the dominant factors in determining the matrix behavior in the composite. (auth)

36580 (COO–1198-896) ANELASTIC STUDIES OF HYDROGEN DIFFUSION IN NIOBIUM. Baker, C.; Birnbaum, H. K. (Illinois Univ., Urbana). Mar 1972. Contract AT(11-1)-1198. 24p. (CONF-720326–1). Dep. NTIS.

From International meeting on hydrogen in metals; Juelich, Germany (20 Mar 1972).

The diffusional behavior of hydrogen in niobium was investigated in the temperature range 20°K using internal friction techniques. In the high-temperature range pulse-echo high frequency measurements were used while flexural vibrations were used in the low-temperature range. Using these techniques the frequency dependence, orientation dependence, and concentration dependence of the hydrogen relaxations were studied in high-purity Nb and Nb–O (N) alloys. Relaxations due to two types of hydrogen complexes were observed: hydrogen pairs, and oxygen (or nitrogen)-hydrogen pairs. The hydrogen pair was found to have an enthalpy of motion of 1265 cal/mole and an enthalpy of binding of 1490 cal/mole. The oxygen (or nitrogen) hydrogen pair was found to consist of a single hydrogen atom bound to the oxygen interstitial with an enthalpy of about 2000 cal/mole. The hydrogen motion enthalpy in the strain field of the oxygen atom was 3900 cal/mole. The relaxations were found to obey a classical Arrhenius temperature dependence at high temperatures and to exhibit enhanced relaxation rates at low temperatures. The results were found to be in agreement with the theory of Flynn and Stoneham for the diffusion of light interstitial solutes. (auth)

36581 (GESR–2081) SOME EFFECTS OF FLUORINE CONTENT ON THE PROPERTIES OF VAPOR DEPOSITED TUNGSTEN TUBING. Danko, J. C.; Festa, J. V. (General Electric Co., Pleasanton, Calif. Special Purpose Nuclear Systems Operation). 30 Sep 1966. Contract AT(04-3)-189. 45p. Dep. NTIS.

Declassified 26 Oct 1971.

Studies were made on the effects of fluorine on the dimensional and microstructural changes in W during high-temperature heat treatments. The results showed that vapor-deposited W with a fluorine content below 20 ppM was found to be dimensionally stable during high-temperature heat treatment. The microhardness of as-deposited vapor-deposited W, grain boundary void formation, and dimensional instability (swelling) of vapor-deposited W at elevated temperatures increased with increasing fluorine content. The grain growth characteristics of vapor-deposited W were a function of fluorine content of the W. High fluorine content had a detrimental effect on the weldability of vapor-deposited W. In high fluorine content W the machinability appeared to be more difficult. Heat treatment of the W prior to machining improved the machining characteristics of the high-fluorine material in particular and also showed some improvement in the low-fluorine content material. The correlation between microhardness and fluorine content of the as-received material was used successfully to provide a qualitative quality control check on incoming material. (P.C.H.)

36582 (JPRS–55942) NONFERROUS METALLURGY. Translation of articles from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, (1972). 17p. NTIS.

Articles are included on effects of surface-active materials on intermetallide crystal growth, effects of W on Laves Phases in Co–Nb–W alloys, phase equilibria in the Nb corner of Nb–Zr–C and Nb–Ti–C systems, and effects of ultrasonic vibrations on structure of Cu. (J.R.D.)

36583 (KFK–1535) INFLUENCE OF MECHANICAL-THERMAL PRETREATMENTS ON THE TIME-TO-RUPTURE AND CREEP BEHAVIOR OF THE STEEL X10 NiCrMoTiB 15 15. Schirra, M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jan 1972. 49p. (In German). Dep. NTIS (U. S. Sales Only).

In order to study the influence of different thermomechanical treatments upon the creep behavior and time-to-rupture of stainless steel X10 NiCrMoTiB 1515 (DIN 1.4970), seven different pretreated samples were investigated. The reason for this investigation was the fact that the yield point of austenitic steels at high temperatures (600 to 800°C) is in the range 12 to 15 kp/mm^2. With respect to the requirements for fuel cladding there exists the necessity to increase the strength and yield point by way of proper treatment. Specimens made from the same heat of a Sandvik steel (12R72HV) were investigated after solution treatment in the temperature range 550 to 800°C and after thermomechanical treatments at 650, 700, and 750°C. Among the pretreatments employed were cold working and annealing at 700 to 850°C. It was found that 15% cold working improved the time-to-rupture most for times $>10^4$ hours and temperatures between 650 and 700°C. The ductility decreased for specimens which were only solution treated with increasing time-to-rupture, while on the other hand it was time independent for sample which underwent a mechanical or thermomechanical treatment. The important creep data for designing fuel element cladding are given for all thermomechanical pretreatments for a wide range of stresses. The metallographic investigations gave insight into crack formation, fracture, and changes in the grain structure. (auth)

36584 (ORO–3604-7) DENSITY DETERMINATIONS USING A GAMMA RADIATION ATTENUATION TECHNIQUE. Fifth Annual Progress Report, September 1, 1970–August 31, 1971. Dillon, I. G. (Tuskegee Inst., Ala. School of Engineering). 30 Sep 1971. Contract AT(40-1)-3604. 13p. Dep. NTIS.

Results of research on high-temperature density of Li are presented. Density data on Li at room temperature to 2100°K were obtained. A description of the experimental methods and equipment is included. (J.R.D.)

36585 (RD/B/N–2229) IGNITION AND COMBUSTION OF SODIUM: A REVIEW. Newman, R. N. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb 1972. 19p. Dep. NTIS (U. S. Sales Only).

The burning of sodium is discussed with regard to the general established rules for metal combustion. It is explained how a surface layer of the products of a metal oxidation reaction may raise the measured ignition temperature above the point where combustion may theoretically commence, and the role of sodium compounds formed between the metal in contact with the air is considered in this context. The burning mechanisms known to apply to the combustion of metals, and their relationships with the physical properties of metal and their oxides, are described, and the thermodynamic data available for the proposed constituents of a sodium flame region are reviewed. (40 references). (auth)

36586 (RFP–1800) GALLIUM CORING PROFILES FOR PLUTONIUM–1 WEIGHT PERCENT GALLIUM ALLOYS. Ferrera, Dennis W.; Doyle, Joe H.; Harvey, Malcolm R. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 11 May 1972. Contract AT(29-1)-1106. 9p. Dep. NTIS.

Cored plutonium-1 weight percent gallium alloys cooled at different rates through the two-phase delta plus epsilon field were examined with the aid of an electron microanalyzer. Gallium concentration profiles were determined across the cored grains and correlated well with predicted profiles, using a new theoretical coring model. Small differences between predicted and measured gallium concentrations at the grain centers were accounted for by a supercooling effect. (auth)

36587 (SC-DC–722299) DYNAMIC MEASUREMENTS OF THE GRUENEISEN COEFFICIENTS OF TANTALUM, URANIUM, AND URANIUM–MOLYBDENUM ALLOYS. Gover, J. E.; Posey, L. D. (New Mexico Univ., Albuquerque. Sandia Labs., Albuquerque, N. Mex.). [1972]. 8p. Dep. NTIS.

Results of work to develop a technique for making dynamic measurements of the Grueneisen coefficients of high atomic number materials and then use this technique to measure the Grueneisen coefficient of uranium, uranium alloyed with 1.5 wt % molybdenum, and uranium alloyed with 10 wt % molybdenum are described. Tantalum was used as the reference material to develop the procedures for data acquisition and interpretation. (auth)

36588 (SU–326-P-17-X-3) STRUCTURE DEPENDENCE OF HIGH TEMPERATURE DEFORMATION OF METALS. Progress Report, March 1, 1971–March 1, 1972. Nix, William D.; Barrett, Craig R. (Stanford Univ., Calif. (USA). Dept. of Materials Science and Engineering). 1 Apr 1972. Contract AT(04-3)-326. 41p. Dep. NTIS.

Studies were made on the structure dependence of high-temperature deformation of metals and alloys. The objective was to develop a deeper understanding of the relation between structure and high-temperature creep and creep rupture of metals and to innovate new ways of improving the creep resistance of metals through structural control. The results reported include studies on: high-temperature creep in Fe−3 % Si; rate controlling mechanism of superplastic flow; high-temperature creep properties of an α-irradiated Ni−6 % W alloy; stabilization of deformed structures by carbide precipitation in Inconel 625; and the importance of including recovery in phenomenological theories of plastic flow in metals. (P.C.H.)

36589 ELECTRICAL-EXPLOSION STUDY OF CERTAIN THERMOPHYSICAL PROPERTIES OF TUNGSTEN AND MOLYBDENUM NEAR THE MELTING POINT. Dikhter, I. Ya.; Lebedev, S. V. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 845-9(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 929-33(Sep-Oct 1971).

A study of the temperature dependence of the heat capacity of solid and liquid molybdenum is reported. The temperature dependence of the resistivity of molybdenum and tungsten was also studied. The measurements were carried out during the heating of metal wires by a high-density current. (auth)

36590 VARIATIONS IN THE MICROHARDNESS AND CRYSTALLINE PARAMETERS OF Zr AS A FUNCTION OF THE OXYGEN CONTENT DETERMINED BY MICROANALYSIS USING NUCLEAR REACTIONS. Boisot, P.; Beranger, G.; David, D.; Amsel, G. (Ecole Nationale Superieure des Mines, Paris). pp 367-73 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972). (In French).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

The direct determination of the diffusion profiles in Zr were used to study simultaneously the variations in the microhardness and some crystalline parameters of Zr as a function of the oxygen content. The method used is based on the observation of the energy spectra of protons emitted at the time of bombardment of the sample with deuterons at 900 keV. The results, particularly the curve representing the c/a ratio variations, showed an anomaly for a concentration in oxygen of 14.5 at. %, with a composition near Zr_6O. The degree of hardness, observed in the zone subadjacent to the oxide, corresponded to a domain of concentration within the composition Zr_6O regardless of the oxidation conditions. It was concluded that the physicochemical properties of the solid Zr−O solutions present a definite anomaly in the vicinity of the Zr_6O composition. The ratio of the parameter c/a was sensibly constant when the oxygen content was less than 10 at. %. At 10 at. % and above, the variation presented an extremely marked peak of which the summit corresponded to about 14.5 at. % with the c/a ratio increasing very rapidly. The stacking tended then to become compact without attaining the value 1.633 corresponding to the ideal compact stacking. It was also interesting to note that the analogy between the Ti−O and Zr−O solid solutions extended equally to the variation of the crystalline parameters. (P.C.H.)

36591 CREEP-RUPTURE BEHAVIOUR OF TYPE 316 AUSTENITIC STEEL IN RELATION TO BORON CONTENT. Williams, T. M.; Harries, D. R.; Furhival, J. (Atomic Energy Research Establishment, Harwell, Eng.). J. Iron Steel Inst. (London); 210: Pt. 5, 351-8(May 1972).

Specimens of type 316 austenitic steel with boron contents in the range 3 to 50 ppM (by weight) were examined in the "as-received" condition, and also after creep-rupture testing, using a combination of optical and electron microscope, electron diffraction, x-ray and boron autoradiographic techniques. The boron was segregated in atomic form at the grain boundaries of the 3, 10, and 30 ppM boron steels (designated BL, AL, and AN respectively) in the "as-received" condition (nominally solution treated at 1050°C and air cooled). Most of the boron was present in particles (probably metal borides and/or B_4C) in the "as-received" 50 ppM boron steel (AM); these particles dissolved progressively during creep-rupture testing at temperatures in the range 600 to 700°C and the boron was redistributed in the structure. The precipitate structures in all the steel specimens tested at 700°C and 8 tonf in^{-2} were essentially the same and consisted of particles at the grain boundaries and within the austenite grains. However, the high-boron steels showed a reduced tendency to intergranular fracture and superior rupture lives and ductilities compared to the low-boron steels in the relatively short-term tests at this stress level. It is suggested that the formation of grain-boundary wedge cracks and cavities at the grain-boundary particles are inhibited as a consequence of a progressive increase in the lattice parameter and/or cleavage strength of the precipitates with boron content. σ-phase formation occurred at the expense of precipitates at the grain boundaries of the BL, AL and AN steels during the more prolonged creep-rupture tests as 700°C and 4½ tonf in^{-2}. These steel specimens failed intergranually, the grain-boundary cracks being associated with the σ-phase particles; however, the highest-boron content steel, AM, exhibited relatively little σ-phase formation and grain-boundary cracking. The superior creep-rupture life and ductility of the Am steel compared with steels BL, AL, and AN are attributed primarily to an increase in the stability of the boro-carbide at the highest boron level, such that the tendency to σ-phase formation and intergranular cracking is reduced. (auth)

36592 INVESTIGATION OF TERNARY SYSTEM Zr–Nb–Ru. Tatarkina, A. L.; Sokolovskaya, E. M.; Raevskaya, M. V.; Sokolova, I. G.; Esipova, A. N. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 1, 64-9(Jan-Feb 1972). (In Russian).

Alloys in the system Zr–Nb–Ru were investigated. Isothermal sections at 1600 and 1050°C were obtained. (auth)

36593 SODIUM-NaK ENGINEERING HANDBOOK. VOLUME I. SODIUM CHEMISTRY AND PHYSICAL PROPERTIES. Foust, O. J. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972). 337p. (TID–26008).

Information is presented on NaK mechanical properties, thermophysical properties, electric properties, and nuclear properties. Information is also presented on NaK analytical chemistry and chemical interactions. (J.R.D.)

36594 SUPERPLASTIC BEHAVIOUR OF ANISOTROPIC METALS THERMALLY CYCLED UNDER STRESS. Lobb, R. C. (Central Electricity Generating Board, Berkeley, Eng.); Sykes, E. C.; Johnson, R. H. Metal Sci. J.; 6: 33-9(Mar 1972).

The creep behavior of uranium and zinc when subjected to low tensile stress and temperature cycles was compared with their behavior under isothermal conditions. High ductilities, sometimes approaching a superplastic level, were obtained under thermal-cycling conditions, in spite of the observed formation of porosity in the specimen and the rapid decrease in density. The progress of void nucleation and growth was also examined. (auth)

36595 EFFECT OF VACUUM-DIFFUSION COATINGS ON THE PROPERTIES OF NIOBIUM AND ITS ALLOYS. Petrovskaya, L. M.; Ponomarenko, E. P. Fiz.-Khim. Mekh. Mater.; 7: No. 5, 82-4(1971). (In Russian).

The protection of Nb and its alloys from the destructive effects of high temperatures and stresses was studied. The most effective method found was the impregnation of surface layers of the alloys with various elements, including Cr, Si, or carbon. The resulting increase in microhardness is attributable to the formation of compounds such as $NbCr_2$, $NbSi_2$, Nb_5Si_3, or in the case of a Ti–Cr–Nb alloy, to $TiCr_2$. (K.S.W.)

36596 IMPURITIES ON THORIUM METAL: AUGER STUDY OF BULK-TO-SURFACE EQUILIBRIA. Ellis, Walton, P. (Los Alamos Scientific Lab., N. Mex.). J. Vac. Sci. Technol.; 9: No. 2, 1027-32(Mar-Apr 1972).

The segregation of impurities on surfaces of polycrystalline thorium metal has been studied by Auger electron spectroscopy. The interstitial contaminants S, C, and P, present in the bulk in the parts per million range, were found to equilibrate rapidly and reproducibly with the surface at elevated temperatures. With sulfur, initially present at 15 ± 5 ppM, three equilibrium ranges were found: (1) at 900–1100°C the surface is saturated, (2) at 1100–1700°C sulfur returns to the bulk with $\Delta H = -48.4 \pm 2.1$ kcal/mole for the reaction S(bulk) → S(surface), and (3) above 1170°C $\Delta H = -18.8 \pm 1.3$ kcal/mole. Corrections were made for changing sulfur Auger peak width. Carbon (285 ppM) returned to the bulk at ~480°C with $\Delta H \simeq -14 \pm 2$ kcal/mole, and phosphorus (50 ppM) returned at ~790°C with $\Delta H \simeq -19 \pm 2$ kcal/mole. The effect was also seen for oxygen and chlorine but no quantitative data were taken. Electron-impact desorption was also observed. (auth)

36597 FORMATION OF METASTABLE LOW TEMPERATURE ALLOTROPIC SOLID SOLUTIONS IN RARE EARTH–ZIRCONIUM SYSTEMS. Wang, R. (Univ. of Southern California, Los Angeles). Met. Trans.; 3: No. 5, 1213-21(May 1972).

The mutual solid solubilities of the heavy rare earth metals (Gd, Tb, Dy, Ho, Er, and Lu) with zirconium have been greatly extended by splat quenching the alloys from the molten state to room temperature. All the retained solid solutions were in the low temperature allotropic form (hcp). X-ray parametric measurements were used to determine the solubility limits. Compared to the solubilities for alloys obtained in the equilibrium condition, the solubility limits of the metastable solid solutions increased more than five times for Gd–Zr and Tb–Zr alloys. Continuous series of solid solutions were obtained in Dy–, Ho–, Er–, and Lu–Zr systems. This is believed to be the first observation of the heavy rare earth elements forming continuous solid solutions with a transition metal in their low temperature allotropic forms. The large extension of the metastable solubilities obtained from liquid quenching was in accord with the martensitic phase transformation of β → α′ types at a high cooling rate (10^7 °C per sec). The present observations can be qualitatively accounted for by the classical rules; however, a semi-quantitative description of the observed increment of the solubility with the increasing atomic number of the rare earth elements was further correlated by the c/a ratios of the hcp alloys. Finally, the metastable solid solubility has been demonstrated by the size factor and the c/a ratio for the elemental crystal structure of rare earth element. (auth)

36598 MECHANISMS OF FATIGUE IN MILL-ANNEALED Ti–6Al–4V AT ROOM TEMPERATURE AND 600°F. Benson, D. K.; Grosskreutz, J. C.; Shaw, G. G. (Midwest Research Inst., Kansas City, Mo.). Met. Trans.; 3: No. 5, 1239-48 (May 1972).

The mechanisms of the fatigue of mill-annealed Ti–6Al–4V were studied at 600°F and room temperature. Early crack initiation ($N_0/N_f \lesssim$ at 0.14) was found to occur in hcp α-grains by a slip-band mechanism under all but the least severe conditions of cyclic stress. Under cyclic stresses near the fatigue limit at room temperature, fatigue cracks began much later ($N_0/N_f \sim 0.4$) at the interface between hcp α and bcc β grains without detectable slip. Under all conditions, Stage I fatigue crack growth occupied 50 to 80% of the total life. Although mechanical twins were produced in profusion near the growing Stage II fatigue cracks, they appeared to play no role in crack initiation or Stage I crack growth; nor did they facilitate Stage II growth. None of the observations could be interpreted as evidence for a metallurgical instability or strain-induced phase transformation which might be harmful to the fatigue resistance of the alloy. (auth)

36599 CREEP RESISTANCE AND HIGH-TEMPERATURE METALLURGICAL STABILITY OF TITANIUM ALLOYS CONTAINING GALLIUM. Shamblen, C. E.; Redden, T. K. (General Electric Co., Cincinnati). Met. Trans.; 3: No. 5, 1299-1305(May 1972).

Tensile properties up to 1100°F and the creep resistance at 1000°F were correlated with composition for twelve complex developmental titanium alloys with additions of Al, Ga, Sn, Mo, Zr, and Si. Creep resistance for these alloys in the β heat-treated condition was found to be strongly dependent on the total α stabilizer content and the silicon concentration. The creep activation energy for a Ti–4.5 Al–2 Sn–3 Zr–3 Ga–1 Mo–0.5 Si alloy, established over the 900° to 1100°F temperature range, was about 100 kcal per g-mole. This high creep activation energy is hypothesized to result from dispersion strengthening within the α matrix by the Ti_3X (X = Al, Ga, Sn) phase and pinning of the interplatelet and prior β grain boundaries by the Zr_5Si_3 phase. Both phases were identified by transmission electron microscopy in these respective locations. Metallurgical instability, as evidenced by decreased fracture toughness, was also found to be relatable to the total α stabilizer content. The activation energy for the embrittlement process was about 45 kcal per g-mole, which approximates that for interdiffusion of gallium in α titanium. (auth)

36600 MECHANISM OF FORMATION OF Mo_2C NEEDLES IN AN Fe–C–Mo ALLOY. Hall, M. G.; Kinsman, K. R.; Aaronson, H. I. (Ford Motor Co., Dearborn, Mich.). Met. Trans.; 3: No. 5, 1320-2(May 1972).

Studies were made on the growth kinetics of Mo_2C needles in an Fe–C–Mo alloy. The results offer evidence that Mo_2C needles grow wholly within the α phase, and that the tips of the needles have a disordered interfacial structure. (P.C.H.)

36601 IN SITU IDENTIFICATION OF THE SILICIDE PHASE IN SUPER-α TITANIUM ALLOYS. Kotval, P. S. (Union Carbide Research Inst., Tarrytown, N. Y.); Calder, R. W. Met. Trans.; 3: No. 5, 1308-11(May 1972).

Identification of the silicide phase in two alloys of the composition (in weight percent) Ti–5 Al–5 Sn–2 Zr–0.8 Mo–0.7 Si and Ti–4.5 Al–2 Sn–3 Zr–3 Ga–3 Mo–0.5 Si by means of electron transmission microscopy and diffraction analyses is described. The value of the lattice parameters used was based on the assumption that in the A_5Si_3 phase, A is a combination of Ti and Zr. The results demonstrated by direct evidence that a hexagonal silicide phase does precipitate in complex super-α silicon-bearing Ti alloys. The zonal indexing of the diffraction patterns from this precipitate confirmed that it was a hexagonal phase with c/a = 0.688 consistent with the structure of the A_5Si_3 phase. (P.C.H.)

36602 ACOUSTIC SURFACE WAVE METHOD FOR RAPID, NONDESTRUCTIVE TEXTURE EVALUATION. Tittmann, B. R.; Alers, G. A. (North American Rockwell Science Center, Thousand Oaks, Calif.). Met. Trans.; 3: No. 5, 1307-8(May 1972).

A simple, rapid method is described for the nondestructive evaluation of texture in metal sheet and plate products of arbitrary thickness. The method uses an impulse technique to generate and receive Rayleigh waves on thick plates or Lamb waves on thin materials. It was applied to Ti alloys where aircraft structural parts demand the optimum in stiffness-to-weight ratio. In this particular case the alloy was Ti−6 Al−2 Sn−4 Zr−6 Mo. A comparison of the various wave types indicated that Lamb waves are more sensitive to texture than Rayleigh waves. However, in different applications the kind of wave that is most suitable should be determined empirically. (P.C.H.)

36603 METALLURGICAL CONSIDERATIONS FOR OPTIMIZING THE SUPERCONDUCTING PROPERTIES OF Nb_3Al. Kohr, J. G.; Eagar, T. W.; Rose, R. M. (Massachusetts Inst. of Tech., Cambridge). Met. Trans.; 3: No. 5, 1177-82(May 1972).

The effects of heat treatment and composition on the superconducting transition temperature of Nb_3Al were studied in conjunction with an x-ray diffraction investigation of ordering and other structural effects. It was determined that an ordering anneal of 750°C for at least 48 hr achieved a maximum midtransition T_c of 18.5°K in arc-melted samples of Nb_3Al. The changes in lattice parameter and order parameter during heat treatment indicate that the β-tungsten crystal structure becomes more ordered as the maximum T_c is approached. Further, the T_c of 18.5°K could not be reached in Nb_3Al material having nonstoichiometric composition. In such material, there was a direct correlation between increasing percentage of second-phase Nb_2Al present and decreasing T_c after the maximum T_c had been obtained. The information obtained during this investigation led to the development of a simple empirical model to explain the change in the T_c of Nb_3Al. Also based on this work, a method was evolved for producing conductor material based on the high T_c Nb_3Al alloy (Appendix I). (auth)

36604 INVESTIGATION OF SOME REGULARITIES IN THE EFFECT OF ALLOYING ADDITIONS ON TEMPERATURES OF POLYMORPHOUS TRANSFORMATIONS OF TITANIUM AND ZIRCONIUM. Braun, S. M.; Samsonov, G. V. (Inst. of Problems in Materials Management, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 12, 1116-19(Dec 1971). (In Ukrainian).

Different alloying elements, with their equal content in titanium and zirconium alloys, change $\alpha \rightarrow \beta$ transformation temperatures to a different degree. Such factors as metallochemical properties (size structure factors), chemical bonding forces, and electronic structure of component atoms determine the degree of the effect of alloying elements on the $\alpha \rightarrow \beta$ transformation temperature. (auth)

36605 PHASE DIAGRAM OF In–Sb AT HIGH PRESSURES. Kornilov, I. I.; Shinyaev, A. Ya.; Chernov, D. B.; Khokhlova, G. I. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 3, 639-42(21 Nov 1971). (In Russian).

Equilibria in the phase composition diagram of In−Sb were studied up to 15 kbars. The temperature dependence of the electrical resistance of alloys with 0.2 and 0.8 atomic fraction of Sb was used in the interpretation of the binary composition diagram at 1 atm, 10 kbars, and 15 kbars. (K.S.W.)

36606 RECIPROCAL DIFFUSION AND THE RELATIONSHIP BETWEEN TITANIUM AND TUNGSTEN AT HIGH TEMPERATURES. Fedotov, S. G.; Ronami, G. N.; Konstantinov, K. M. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 3, 628-31(21 Nov 1971). (In Russian).

The mutual diffusion of layers of Ti−W at 1,000 to 1,600°C was studied by an x-ray spectral method. The extent of dispersal of a β-solid solution and the calculated coefficients of reciprocal diffusion were obtained over this temperature range. (K.S.W.)

36607 HEAT OF FUSION OF VANADIUM. Berezin, B. Ya.; Chekhovskoi, V. Ya.; Sheindlin, A. E. (Inst. of High Temperatures, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 3, 583-5 (21 Nov 1971). (In Russian).

A sample of V was selected for thermal measurements which had 0.06% impurities, a density of 6.1 g/cm^3 at 20°C, an electrical resistance of 21.02 micro-ohm · cm, and a melting point of 2,190°K. Enthalpy equations are given which apply to solid and liquid V, respectively, above and below 2,190°K. The heat of fusion of this sample of V was then calculated to be 5,511 ± 113 cal/g.atom. (K.S.W.)

36608 FUNDAMENTAL ASPECTS OF DISLOCATION THEORY. VOLUME I. Conference Held at Gaithersburg, Maryland, April 21–25, 1969. Simmons, John A.; deWit, R.; Bullough, R. (eds.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 317, 1-726(Dec 1970). (CONF-690462–(Vol.1)).

Approximately 47 papers are presented in Vol. I. A separate abstract was prepared for each of two papers. Papers for which no abstracts were prepared are concerned with discrete dislocations in continuum elasticity, lattice theories, dislocation-phonon interactions, and geometry of dislocations. (J.R.D.)

For abstracts of individual papers see: 36609 and 36610.

36609 STRUCTURAL AND ELASTIC PROPERTIES OF ZONAL TWIN DISLOCATIONS IN ANISOTROPIC CRYSTALS. Yoo, M. H.; Loh, B. T. M. (Oak Ridge National Lab., Tenn.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 317, 479-93(Dec 1970). From Conference on fundamental aspects of dislocation theory; Gaithersburg, Md. (21 Apr 1969).

A descriptive definition of zonal twin dislocations for compound twin systems is given based on the well established rational crystallographic elements. Geometric characteristics of zonal twin dislocations in double lattice structures are thoroughly discussed. Equilibrium shapes of an incoherent twin boundary have been analyzed by using the anisotropic elastic properties of edge dislocations. Short-ranged structural properties of zonal twin dislocations are discussed based on a Peierls−Nabarro model. It is found that the "anisotropic parameter," K_eS_{66}, correctly predicts the active mode of crystallographically non-equivalent conjugate twin systems. (auth)

36610 NON-PLANAR DISSOCIATIONS OF DISLOCATIONS. Mendelson, S. Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 317, 495-529(Dec 1970). From Conference on fundamental aspects of dislocation theory; Gaithersburg, Md. (21 Apr 1969).

Results of a study are presented in which anisotropic elasticity is applied to dislocation dissociations in hcp, fcc, bcc, diamond lattices, and tetragonal and orthorhombic crystal structures. Formulations for the dissociation equation, zonal dislocations, twinning elements, and forces on the glissile partials are included. (J.R.D.)

36611 FUNDAMENTAL ASPECTS OF DISLOCATION THEORY. VOLUME II. Conference Held at Gaithersburg, Maryland, April 21–25, 1969. Simmons, John A.; deWit, R.; Bullough, R. (eds.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 317, 729-1338(Dec 1970). (CONF-690462–(Vol.2)).

Approximately 37 papers are presented in Vol. II. A separate abstract was prepared for each of two papers. Papers for which no abstracts were prepared are concerned with field theories, thermally activated processes and statistical theories, and dislocation-electron interactions. (J.R.D.)

For abstracts of individual papers see: 36612 and 36613.

36612 PROBLEM OF NON-LOCALITY IN THE MECHANICS OF SOLIDS: REVIEW ON PRESENT STATUS. Kroener, E. (Technische Univ., Clausthal, Ger.). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 317, 729-36(Dec 1970). From Conference on fundamental aspects of dislocation theory; Gaithersburg, Md. (21 Apr 1969).

The concept of non-locality, in particular with reference to the mechanics of solids, is discussed. A brief report is given on the derivation of the non-local theory of elasticity from atomic lattice theory. In addition, solutions of this theory concerning the interaction of dilatation centers and wave propagation are quoted. A generalization of the theory which would include dislocations is indicated. (auth)

36613 THEORIES OF THERMALLY ACTIVATED PROCESSES AND THEIR APPLICATION TO DISLOCATION MOTIONS IN CRYSTALS. Engelke, H. (Univ., Stuttgart). Nat. Bur. Stand. (U. S.), Spec. Publ.; No. 317, 1137-56(Dec 1970). From Conference on fundamental aspects of dislocation theory; Gaithersburg, Md. (21 Apr 1969).

The validity of analyzing the plastic behavior of crystals as related to thermally-activated processes involving dislocations, by application of the theory of absolute reaction rates and the string approximation of dislocation, is evaluated. Discussions are included on thermally-activated processes and double kink relaxation processes. (J.R.D.)

36614 DISLOCATION-ASSOCIATED INTERNAL FRICTION IN MOLYBDENUM MONOCRYSTALS IRRADIATED WITH ULTRASOUND. Belostotskii, V. F.; Polotskii, I. G. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 11, 1905-6 (Nov 1971). (In Russian).

The attenuation of ultrasound resulting from dislocations was investigated in Mo monocrystals which were irradiated with ultrasound. This attenuation was studied as functions of the amplitude of the oscillations, irradiation time, and annealing temperature. With increase in the amplitude of the ultrasound, attenuation increased, but remained less, however, than after plastic deformation for an equivalent density of deformations. Conversely, attenuation decreased when plastically deformed samples were irradiated. The results are discussed in the light of the theory of Granato and Lucke (1956). Ultrasonic radiation, together with a greater dislocation density, results in a greater immobilization of recent point defects than is the case for plastic deformation. The relation to ultrasonic radiation is thus analogous to irradiation by nuclear particles or low-temperature annealing. (tr-auth)

Radiation Effects

Refer also to abstracts 37755 and 37816.

36615 (ANL–7889) EFFECT OF BURNUP, SWELLING, AND IRRADIATION TEMPERATURE ON THERMAL DIFFUSIVITY AND CONDUCTIVITY OF URANIUM–FISSIUM ALLOY. di Novi, R. A. (Argonne National Lab., Ill.). Jan 1972. Contract W-31-109-eng-38. 18p. Dep. NTIS.

The postirradiation measurements of the thermal diffusivity and thermal conductivity of specimens of U-5 wt% Fs alloy that had been irradiated over a range of values to 1.12 at.% burnup and up to 600°C are described. Large reductions in the values of these thermal properties (as much as 30%) were measured, and the results are interpreted as being due to solid and gaseous fission-product accumulations in the fuel. A relationship is established between the fuel swelling and the decrease of the thermal conductivity that is suitable for predicting the change in conductivity with irradiation. (auth)

36616 (CONF-720604–1) NEUTRON IRRADIATION DAMAGE IN A PRECIPITATION-HARDENED ALUMINUM ALLOY. King, R. T.; Jostsons, A.; Farrell, K. (Oak Ridge National Lab., Tenn.). 1972. 28p. Dep. NTIS.

From Symposium on the effects of radiation on structural materials; Los Angeles, CA. (26 Jun 1972).

A 6061 aluminum alloy target sleeve from the High Flux Isotope Reactor, originally in a precipitation-hardened condition, was examined for neutron radiation damage after exposure to a maximum fast fluence of 9.2×10^{22} n/cm^2 ($E > 0.1$ MeV) and a thermal fluence of 1.2×10^{23} n/cm^2 at 60°C. Voids and a transmutation-produced silicon precipitate were found to cause about 1.1% internal swelling; a surface oxide scale contributed additional swelling. Radioinduced strength increases were measured at test temperatures in the range 25 to 200°C and were accounted for in terms of the observed silicon precipitate and an associated dislocation structure. There was also a loss of ductility that was most severe at 200°C. The fracture mode remained transgranular over the range of test temperatures. (auth)

36617 (HEDL-TME–72-35) COMPUTER CALCULATIONS OF GROWTH RATES OF VOIDS IN STAINLESS STEEL DURING NEUTRON IRRADIATION. Straalsund, J. L.; Guthrie, G. L. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1972. Contract AT(45-1)-2170. 23p. Dep. NTIS.

Calculations have been made of the growth rate of voids in a solid having material parameters similar to those of stainless steel. The calculations have been made for 10^9 to 10^{12} dislocation lines per cm^2, 10^{13} to 10^{16} voids per cm^3, externally applied negative hydrostatic pressures of 0 to 14,500 psi, and temperatures from 350 to 600°C, with various initial void sizes and several different amounts of trapped gas in the voids. The calculations were made for the case of each void being in a spherical cell and for a constant and spatially uniform generation rate of Frenkel pairs. Recombination was included. The negative external pressure was found to cause an additional growth which was more important at high temperatures, but which was unlikely to result in net growth at temperatures over 600°C. The hydrostatic pressure was found to affect the size of the critical nucleus. Trapped gas stabilization was found to be of potentially great importance at the higher temperatures. Possible treatments of nucleation are discussed. Time dependence of swelling was found to vary from $S \propto t^0$ to $S \propto t^3$, depending on densities of dislocations and densities and sizes of voids. Integration of growth rates under the assumption that nucleation is limited to the initial part of the irradiation exposure led to swelling curves whose magnitudes and trends were consistent with observed histories of irradiated materials. By means of this program, reliance on extrapolation of observed swelling to values to be anticipated at higher fluences seems practical. (auth)

36618 (HW–67110) IRRADIATION OF NATURAL URANIUM SEVEN-ROD CLUSTER FUEL ELEMENTS IN THE ENGINEERING TEST REACTOR, GEH-10-2 (RM-281). Final Report. Call, R. L.; Claudson, T. T.; McMahan, M. E. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). Mar 1962. Contract AT(45-1)-1350. 33p. Dep. NTIS.
Declassified 4 Nov 1971.

Three seven-rod cluster, natural uranium fuel elements fabricated from coextruded Zircaloy-2-clad uranium were irradiated to an average exposure of 950 MWd/t. The core center temperature of the elements during the major part of the irradiation was 405°C with a specific power of 67.5 kW/ft. During the latter part of the irradiation core temperature was 516°C with a specific power of 125.5 kW/ft. Except for the failure of the end supports of two of the clusters during or after discharge, the general appearance of the clusters was good. Some of the rods were warped slightly but their surfaces were smooth and free of bumps. No film was deposited on the rods and no evidence of cladding or weld corrosion was observed. The rod which was measured had increased in volume 1.64 percent at 0.18 percent burnup of its uranium atoms. There were no cracks in the uranium and the uranium-to-cladding bond layer was sound. The uranium microstructure was characteristic of irradiated uranium. Results of the test show that seven-rod cluster fuel elements can be irradiated successfully at high temperatures and powers to exposures as high as 1000 MWd/t. The failure of the end supports was not caused by irradiation, per se, but was a result of the need to remove material from the end supports so that the fuel elements could be fitted into the basket for irradiation. (auth)

36619 (RISO–256, pp 53-67) DISPERSION-STRENGTHENED ZIRCONIUM PRODUCTS FOR WATER-COOLED REACTORS. Adolph, E.; Hansen, N. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.
In Aspects of research at Risoe.

To improve the strength of zirconium alloys at high temperatures a powder metallurgy process was developed for manufacture of Zircaloy-2 dispersion strengthened with yttria (Y_2O_3). Alloys with up to 10 volume per cent of yttria were produced in a high-purity argon atmosphere to ensure a very low impurity content in the final material. The alloys were tensile-tested and creep-tested in the range room temperature to 600°C, and corrosion-tested in steam at 400°C. A number of alloys were exposed to neutron irradiation before testing. This development resulted in dispersion-strengthened alloys with good thermal and irradiation stability, twice the strength of Zircaloy-2, and a corrosion resistance comparable to that of Zircaloy-2. (auth)

36620 (STU–70-419/U-350-a) PART 1:1. METALLOGRAPHIC STUDY OF NEUTRON IRRADIATED AND UNIRRADIATED 12R72HV AFTER TENSILE TESTING. Lindhagen, P.; Westin, R.; Hellstrand, E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). May 1971. 26p. (In Swedish). (AE-MF–204). Dep. NTIS (U. S. Sales Only).

A metallographic study of neutron-irradiated, as well as unirradiated, 12R72HV steel after tensile testing is described. Before testing, the steel was annealed at 1150°C as well as cold-worked to 15% and annealed at 830°C. It was found that neutron irradiation lowered the ductility by tensile testing in the temperature range 500 to 800°C. Helium bubbles formed by plastic deformation prevented dislocation movements. It was established that there was only a slight grain deformation before crack. Comparison has been made with earlier observations after heat treatment at 1100°. The lowering of ductility according to irradiation was less in these earlier observations. This can be explained with smaller grain size, more favorable titanium carbide structure, and bigger helium bubbles. (Sweden)

36621 EFFECT OF FISSION FRAGMENT IRRADIATION UPON THE OXIDATION OF A 15Cr–4Al–0.86Y FERRITIC STEEL BY OXYGEN AT 650 AND 800 C. Bennett, M. J.; Chaffey, G. H.; Antill, J. E. (Atomic Energy Research Establishment, Harwell, Eng.). pp 155-63 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Studies on the oxidation of 15Cr–4Al–0.86Y ferritic steel by oxidation as a result of irradiation with a fission fragment flux of 1.34 to 1.78×10^9 ff/cm^2 sec showed that the oxidation was decreased at 800 but was uninfluenced at 650°C. The oxidation behavior at the higher temperature was not affected by the associated incident reactor radiations. This radioinduced effect was apparent even after 48 h and became more significant with longer exposures up to 5889 h. Two possible mechanisms for the radiation effect are discussed. (P.C.H.)

36622 RADIOLYTIC CORROSION IN COOLING WATER CIRCUITS OF HIGH ENERGY PARTICLE ACCELERATORS AND ITS INHIBITION. Hoyer, Fritz E. (CERN, Geneva). pp 164-7 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

For the examination of the effects of radiolytic corrosion on Cu cooling ducts, a circuit simulator was constructed and placed in the extracted 600 MeV proton beam of the CERN Synchrocyclotron. The experiments were performed with pure demineralized water and with water containing inhibitors like hydrazine and benzotriazole. The corrosion caused by demineralized water was tested under the same conditions, but without irradiation. Hydrazine was added directly to the water (0.5 mmole/l). The results showed that benzotriazole was the most efficient inhibitor. The treated surface behaved as if it had been reduced to 8% of its geometrical dimensions. The protective effect of hydrazine seemed to persist for no longer than about 1 h. (P.C.H.)

36623 AQUEOUS CORROSION AND HYDRIDING OF ZIRCONIUM ALLOYS IN NUCLEAR REACTOR ENVIRONMENTS. Johnson, A. B. Jr. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. pp 168-77 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

The results of in-reactor corrosion studies at Battelle-Northwest, emphasizing experience in the G-7 pressurized water loop of the Engineering Test Reactor (ETR) at 270 to 280°C, are summarized. Specimens of four alloys (Zircaloy-2, low-Ni Zircaloy-2, Zircaloy-4, and Zr−3Nb−1Sn) were exposed in the pH 10 LiOH, oxygenated (~1 ppM) G-7 loop coolant. Specimens of seven alloys (Zircaloy-2, Zircaloy-4, Zr−1.2Cr−0.08Fe, Zr−1.2Cu−0.28Fe, Zr−2.5Nb, Zr−3Nb−1Sn, and Ozhennite 0.5) were exposed in the pH 10 NH_4OH G-7 loop coolant. There was abundant evidence that dissolved oxygen in the coolant is a major factor in radiation-enhanced corrosion of Zr alloys. Corrosion mechanisms are also discussed. (P.C.H.)

36624 EFFECTS OF RADIATION ON THE CORROSION OF SOME ZIRCONIUM ALLOYS. Asher, R. C.; Davies, D.; Kirstein, T. B. A.; McCullen, P. A. J.; White, J. F. (Atomic Energy Research Establishment, Harwell, Eng.). pp 178-85 of Proceedings of the Fourth International Congress on Metallic Corrosion. /Hamner, Norman E. (ed.). Houston, Tex.; National Association of Corrosion Engineers (1972).

From fourth International Metals Corrosion Congress proceedings; Amsterdam, Netherlands (7 Sep 1969).

Studies were made on the effects of reactor radiation on the corrosion of Zircaloy-2, Zr−2.5% Nb, and Zircaloy-4. Intensities of neutrons and of γ radiation typical of a power reactor, viz $\sim 4 \times 10^{13}$ n cm^{-2} sec^{-1} fast neutrons (>1 MeV), $\sim 4 \times 10^{14}$ n cm^{-2} sec^{-1} thermal neutrons, and $\sim 10^{9}$ R h^{-1} γ. The results showed that irradiation can enhance the corrosion of Zircaloy-2 and of Zr−2.5% Nb alloy by factors of the order of 10. The enhancement was most significant in the post-transition region and in the temperature range 250 to 350°C; it disappeared at 400°C and above. With Zr−2.5% Nb alloy, a slight suppressing effect of radiation in the early part of the pre-transition region was observed under certain conditions. Detailed corrosion behavior under radiation was quite different in gaseous corrodents (steam and impure CO_2) from that in liquid water. A consistent effect of irradiation on the percentage hydrogen pick-up during corrosion was not established. (P.C.H.)

36625 COMPUTER SIMULATION OF RADIATION DAMAGE IN Fe_3Al. Jackson, Roland O.; Leighly, H. P. Jr.; Edwards, D. R. (Univ. of Missouri, Rolla). Phil. Mag.; 25: No. 5, 1169-93(May 1972).

A computer simulation of the ordered Fe_3Al lattice was devised. This lattice array consisted of 559 atoms interacting with two-body forces. To simulate radiation damage, a selected atom was given a known kinetic energy in a predetermined direction. The damage threshold in the [100] direction was found to be 22 eV while in the [110] direction the threshold was 44 eV. Vacancies and interstitials were found to be the normal stable defects, the interstitial residing in the split configuration oriented in the [110] direction. Replacement chains were prevalent in the [100] and [110] directions. Focusons served as the primary mechanism for dissipating energy from the collision chains in the [110] and [111] directions. Along a defocusing chain the energy dissipation appeared to resemble a thermal spike, while near the end of the chain, especially in the [111] direction, there was an extensive lattice expansion due to energy dissipation which appeared to give a plasticity spike. Disordering in the ordered alloy appeared to be most significant along defocusing chains. (auth)

36626 MECHANICAL PROPERTIES OF NEUTRON IRRADIATED MILD STEELS. Little, Edward Alan. London: Univ. of London (1971).

Thesis.

The strengthening mechanisms in mild steels neutron irradiated to doses up to 2.6×10^{18} n/cm^2 (fission) were investigated. In particular, the role of interstitial nitrogen in affecting the radiation hardening was studied. Data on radiation hardening in En2, silicon-killed, and aluminium-grain-size-controlled mild steels were correlated with their interstitial nitrogen contents, assessed using internal friction, chemical analysis, and strain-ageing methods. Increasing or decreasing the nitrogen levels in the steels by suitable heat-treatments before irradiation induced corresponding increases or decreases, respectively, in radiation hardening. The results demonstrated that interstitial nitrogen enhances radiation hardening in mild steels. Nitrogen in the silicon-killed steel was progressively removed from solution with increasing neutron dose, and returned to solution in the same annealing temperature range (300 to 400°C) as the radiation hardening recovered. Theoretical analysis indicated that nitrogen markedly reduced the "effective" self-interstitial migration rate and was eventually trapped at the periphery of small faulted {110} dislocation loops, 4 to 19 Å in diameter, created during irradiation. It was tentatively concluded that nitrogen enhanced the radiation hardening by increasing the loop density and/or by stabilizing the {110} loops. The latter represent stronger obstacles than the perfect {111} loops observed in bcc metals irradiated to high doses. The temperature and strain-rate dependence of the yield stress of the aluminium-grain-size-controlled steel irradiated to 2.3×10^{18} n/cm^2 (fission) were measured in the range −196 to 250°C, and used to evaluate activation parameters. Below ~23°C the radiation hardening was temperature independent; and up to −78°C the results were consistent with the mechanism based on surmounting of Peierls stress hills. Thermal activation of the radiation damage was detected above ~23°C. It is inferred that the loops responsible for strengthening are interstitial in nature, <10 Å in diameter, and spaced ~40 to 60 Å apart. The hardening could be caused either by the interaction of glide dislocations with their tetragonal strain fields or by direct contact interaction. (auth)

36627 LOW CYCLE FATIGUE BEND TEST METHOD FOR THIN SECTION MATERIAL. Broomfield, G. H. (United Kingdom Atomic Energy Research Establishment, Harwell, Eng.); Hutchins, E. E. C. Metals Mater.; 6: No. 3-4, 150-4(Mar-Apr 1972).

A low cycle fatigue bend test for thin section material was developed for studying the post-irradiation high strain fatigue properties of steel for AGR fuel cladding. The method is described and an indication is given of the method of assessing the plastic strain imposed on the specimen. (UK)

36628 EFFECT OF γ RADIATION ON THE TEMPERATURE OF THE SOLID−LIQUID PHASE TRANSITION IN ALUMINUM. Danil'chenko, B. A.; Krulikovskaya, M. P. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 11, 1914-16(Nov 1971). (In Russian).

The transition temperature of the liquid ⇌ solid phases in aluminum (t_s) was investigated while being subjected to ^{60}Co gamma radiation at 1,000 to 1,200 R/sec. The value of t_s was lowered during irradiation, and the degree of change was greater for crystallization than for fusion. At the maximum γ field strength the t_s for crystallization decreased by 1.9°C, whereas the t_s for fusion decreased by only 0.7°C. (tr-auth)

Other Materials

Refer also to abstract 37757.

36629 (AECL-3958) AN ESTIMATION OF THE PROBABILITY OF FATIGUE FAILURE OF SOME GRAPHITES. Wilkins, B. J. S.; Reich, A. R. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Feb 1972. 25p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

Engineering design of structural ceramic components has to make allowance for fatigue failures. A method has been developed to estimate the probability of such failures. The application of this method to published data for graphites is described. The estimates obtained were very conservative because data in the literature were not in the specialized form required by the method. Nevertheless, the estimates were useful and were used to illustrate the effects of the fatigue limit and of fracture strength and its variability for POCO and RC4 graphites. Also included is a hypothetical material, Hy-POCO graphite, which is as strong as POCO but as variable as RC4 graphite. The results indicated the great importance of the fatigue limit, and that permissible service stresses are greatest for the strongest, least variable graphite. Proof testing also was desirable because, as the proof stress was increased, so was the maximum operating stress for any given probability of failure. This was more noticeable in the more variable graphites and had practical importance because it improved their performance significantly. (auth)

36630 (BDX–613-582(Rev.)) FABRICATION OF POLYIMIDE SYNTACTIC FOAM PARTS. Final Report. McIlroy, H. M. (Bendix Corp., Kansas City, Mo.). Dec 1971. Contract AT(29-1)-613. 37p. Dep. NTIS.

Polyimide foam parts have been made from a blend of a polyamic acid solvent solution and glass microballoons. A loss of solvent during cure results in a weight loss of about 75 percent and linear shrinkage of 15 percent with a final part specific gravity of 0.32. (auth)

36631 (CERN-Trans–71-36) EFFECT OF NEUTRON IRRADIATION ON CERTAIN PROPERTIES OF REFRACTORY CONCRETES. Dubrovskii, V. B.; Ibragimov, Sh. Sh.; Ladygin, A. Ya.; Pergamenshchik, B. K. Translated by B. Hodge (CERN, Geneva, Switzerland), from At. Energ. (USSR); 21: 108-12(1966). 12p. Dep. NTIS (U. S. Sales Only).

Unlike that of the materials used in the construction of nuclear reactors, the radiation resistance of concretes used for biological protection has been insufficiently studied. At present there is a tendency to use for biological protection mainly refractory concretes instead of the relatively expensive materials which are in short supply (steel, pig iron, graphite, boron, etc.). For this reason, studies were made on the effects of reactor irradiation by neutrons on certain properties of refractory chromite concretes based on Portland cement and water-glass. The overall neutron flux was 2 to 2.4×10^{21} n/cm^2, and the irradiation temperature was up to 550°C. It was established experimentally that these concretes retain fairly high characteristics of strength and elasticity. The thermal conductivity and coefficient of thermal expansion varied only slightly. It was concluded that these concretes may be recommended for use in the biological shielding of nuclear reactors. (auth)

36632 (GULF-GA-A–10971) RESEARCH ON GRAPHITE. Quarterly Progress Report for the Period Ending December 31, 1971. Engle, G. B.; Price, R. J. (Gulf General Atomic Co., San Diego, Calif.). 28 Jan 1972. Contract AT(04-3)-167. 8p. Dep. NTIS.

The results of research on graphite for the period October 1 through December 31, 1971, are reported. No experimental work was performed. Specimens irradiated previously in capsule GE–H–13–18 at 500° to 1400°C up to fluences of 10^{22} n/cm^2 have been reirradiated to higher fluences in capsule GE–H–13–19. A review of recent developments in irradiation-induced changes in graphites at high temperatures and high fluences has been initiated. Fundamental changes in the crystallites, dimensional and property changes, microstructural changes, and creep characteristics are covered. (auth)

36633 (SC-DR–720260) CHARPY TOUGHNESS OF DISCONTINUOUS FIBER REINFORCED PLASTICS. Allred, R. E.; Schuster, D. M.; Apodaca, M. P. (Sandia Labs., Albuquerque, N. Mex.). Apr 1972. 17p. Dep. NTIS.

Previous theories for the impact strength of discontinuously reinforced composites predict that the toughness is a maximum when critical transfer length fibers are used. Experiments utilizing mini-Charpy specimens of unidirectional boron-fiber reinforced-epoxy resin have been conducted which corroborate this prediction. However, calculations of the fracture energy, based on a uniform interfacial shear stress during fiber pullout, proved inadequate for the reinforced-epoxy composites. Revisions to existing theories are presented to take into account the nonuniformity of the interfacial shear stress distribution along the fiber length and catastrophic failure of the interfacial bond. (auth)

36634 ELECTROCONDUCTIVITY OF MELTS IN THE SYSTEM In_2Se_3–K_2Se. Velikanov, A. A.; Shevchuk, P. P.; Malinovskii, V. V.; Grigorenko, N. F. (Kiev State Univ.). Ukr. Khim. Zh.; 27: No. 12, 1224-7(Dec 1971). (In Russian).

The electric conductivity, polarization characteristics, and electrolysis behavior of In_2Se_3–K_2Se melts were studied over a broad range of composition and temperature. The conductivity of all compositions increased exponentially with increase in temperature. The conductivity initially fell with increased K_2Se content to a minimum at 50 mole % K_2Se, and then rose to a maximum at 70 mole % K_2Se. (K.S.W.)

36635 POLYTETRAFLUOROETHYLENE: EFFECTS OF γ RADIATION ON FINE STRUCTURE. Pinkerton, D. M. (Australian Defence Scientific Service, Ascot Vale). Thompson, K. R. L. J. Polym. Sci., Part A-2; 10: No. 3, 473-88(Mar 1972).

The structure of granular polytetrafluoroethylene (PTFE) was studied by electron microscopy. On the basis of the texture of surfaces resulting from fracture a model of the structure is proposed, which suggests that PTFE consists of extended chain crystals with both inter- and intra-lamellar noncrystalline regions. The effects of γ radiation on the structure were investigated by examining the texture of irradiated fracture surfaces and also the texture produced by post-irradiation fracture. The irradiations were performed in vacuo and in oxygen. In both atmospheres, PTFE undergoes degradation with a concurrent increase in crystallinity. However, the texture of the surfaces of high crystallinity PTFE, prepared by radiation, differs markedly to the texture of fracture surfaces of high crystallinity PTFE prepared by thermal annealing. It is proposed that radiation causes rupture of bonds in the interlamellar (chain fold) and intralamellar regions, resulting in the production of chain ends and interlamellar links. Due to scavenging of the free radicals, interlamellar linking is probably a minor process with irradiation in oxygen. These chemical changes cause modifications to the extended chain lamellar crystals and consequently alterations to the physical properties of the polymer. (auth)

36636 ELECTRON BEAM MICROANALYSIS OF CARBONS. I. X-RAY INTENSITIES OF C-Kα-LINE. Weisweiler, Werner (Univ., Karlsruhe, Ger.). Mikrochim. Acta; No. 2, 145-62(1972). (In German).

Using elementary carbon as an example it was shown that, depending on the physical state of the pure solid-body specimens (morphology, disorder, orientation), the measured intensities of the C Kα line vary. The intensity from diamond is 24% higher, and that from pyrographite 17% higher than that from vitreous carbon, whereas lesser intensities, up to 28%, were measured from other carbons. Studies on various crystallographic surfaces of pyrographite in comparison with isotropic carbon serve to clarify the differences. The self absorption of the C Kα radiation parallel and perpendicular to the bedding planes of the graphite lattice were found at 2500 and 2160 cm^2/g, provided they are referred to the experimental value of μ/ρ = 2535 cm^2/g found for carbon deposited by distillation. Direct absorption measurements on very thin filters made of graphite and isotropic carbon confirmed the various diminution values. Of greater influence on the Roentgen intensity are the various absorption paths from the place of the origin of the radiation to the place of departure from the specimen. If the electron beam is perpendicular to the graphite layers, the pear-shaped sojourn volume of the diffusing electrons is flattened by approximately 10.5%. If the beam is parallel to the layers, it is extended by around 6%. The portion of the enclosed electrons taken up by the specimen is influenced but slightly by the body density and the surface state. In the case of known absorption relationships, the intensity deviations of the carbon with each other can be interpreted. (auth)

36637 EFFECT OF RADIATION ON THE SPECIFIC HEATS OF POLYETHYLENE AND POLYSTYRENE. Savina, V. P.; Briskman, B. A.; Bondarev, V. D. (Scientific-Research Physical-Chemical Inst., Moscow). Vysokomol. Soedin., Ser. A; 14: No. 5, 1180-6(May 1972). (In Russian).

The effect of absorbed radiation dose on the specific heats of high-pressure polyethylene (PE) and amorphous polystyrene (PS) was studied in the dose range 0 to 5000 Mrad and the temperature range 30 to 160°C for PE and 30 to 200°C for PS. The specific heat of PE decreases with the dose increase at low temperatures (30 to 50°C) and passes through a maximum (at about 200 Mrad) at high temperatures (70 to 80°C). In the case of PS no dependence of the specific heat on the dose was found. The specific heat vs temperature plot showed sharp peaks in the range 142 to 192°C, which disappeared after heat treatment. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 35994 and 36313.

36638 DECREE OF 10 SEPTEMBER 1969 ON THE APPLICATION OF ARTICLES 28 TO 32 OF THE NUCLEAR ENERGY ACT (DECREE ON RADIOACTIVE MATERIALS). Staatsblad van het Koninkrijk der Nederlanden; No. 404, 929-38(9 Oct 1969). (In Dutch).

This decree establishes the conditions to be satisfied for approval of the production, storage and use of radioactive materials with activities exceeding 0.002 microcuries per gram, and provisions concerning the use and disposal of radioactive materials. (Occup. Safety and Health Abstr.)

Disposal and Storage

Refer also to abstracts 36111, 36638, and 37721.

36639 (CEA-R-4310) DRY STRUCTURES AND CAPILLARY BARRIERS IN POROUS MEDIA, APPLICATION TO THE STORAGE IN SOIL. Rancon, Daniel (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Feb 1972. 34p. (In French). Dep. NTIS (U. S. Sales Only).

It was experimentally demonstrated that it is possible to create dry structures in unsaturated porous media operating only on the difference in grain sizes. The mock-up consists of a layer of fine sand overlaying a stratum of coarse sand. The water is fed at a point on the surface of the fine sand and seeps into it but does not get in the coarse sand whatever the form of the interface separating the two media. This phenomenon is due to the fine sand capillarity and to gravity. The water moves through the coarse sand only when the total layer of fine sand is wetted. A dry structure is created, even during an unsaturated steady state infiltration if the coarse sand is surrounded on all sides by fine sand. The phenomenon is essentially due to the suction by the fine sand and the limit grain size above of which it does not occur has been determined. Several applications may be related to this phenomenon, such as the improvement of the storage in the soil of radioactive wastes. The report is illustrated by a film. (auth)

36640 (ORNL-4720, pp 11-13) DISPOSAL BY HYDRAULIC FRACTURING. de Laguna, Wallace; Cowser, K. E.; Tamura, Tsuneo; Sealand, O. M. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

RADIOACTIVE WASTE—disposal by hydraulic fracturing, pressure-decay data from West Valley, N. Y. studies on
ROCKS—radioactive waste injection into deep underground, by hydraulic fracturing, pressure-decay data from West Valley, N. Y. studies on (R.C.K.)

36641 (ORNL-4720, pp 14-19) DISPOSAL IN NATURAL SALT FORMATIONS. Empson, F. M.; Hodge, T. W. Jr.; Lomenick, T. F.; McClain, W. C.; Wyrick, H. J. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

KANSAS—site of Project Salt Vault in Lyons, geology and hydrology of
RADIOACTIVE WASTE—disposal in salt deposits, geology and hydrology of Lyons, Kansas site for
SALT DEPOSITS—geology and hydrology of Lyons, Kansas, for proposed radioactive waste repository (R.C.K.)

36642 (ORNL-4720, pp 20-2) ENGINEERING, ECONOMIC, AND SAFETY EVALUATIONS. Cowser, K. E.; Fowler, P. G.; McNeilly, G. S.; Reeves III, Mark (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

OAK RIDGE AREA (TENN.)—radiation dose rate in environs of, following stack disposal of radioactive wastes, computer calculations of
RADIATION DOSE—calculation for Oak Ridge environment following stack disposal of radioactive wastes
RADIOISOTOPES—release to atmosphere from nuclear facilities, computer calculations of dose rate in Oak Ridge environment from
STACK DISPOSAL—radiation dose to Oak Ridge environment from nuclear facilities, computer calculations of (R.C.K.)

36643 (ORO-693) PRELIMINARY GEOLOGICAL INVESTIGATIONS OF SUPPLEMENTAL RADIOACTIVE WASTE REPOSITORY AREAS IN THE STATE OF KANSAS. Angino, Ernest E.; Bayne, Charles K.; Halepaska, John (eds.) (Kansas Univ. Center for Research, Inc., Lawrence. Kansas State Geological Survey, Lawrence). Jan 1972. Subcontract 3484. 102p. ORO.

For Union Carbide Corp., [Oak Ridge, Tenn. Nuclear Div.].

A preliminary study was made during 1971 of the surface geology and hydrology and subsurface geology of areas in central and western Kansas with the purpose of focusing on areas other than Lyons, Kansas which may be considered as supplemental radioactive waste repository sites. The criteria for selecting certain areas for study are given. For each area selected detailed information is presented on: geology; hydrology; population; oil and gas fields; characteristics of salt deposits; and potential of area for gas, oil, and recreational development. (L.C.L.)

36644 DETERMINATION OF THE CONDITIONS OF STORAGE OF EMANATING SUBSTANCES. Novikov, V. I.; Bad'in, V. I. Gig. Sanit.; No. 1, 66-9(Jan 1972). (In Russian).

The dependence of the concentrations of emanations and their daughter products on the multiplicity of air exchange was determined. On the basis of this dependence the maximum admissible quantity of emanating substances was calculated for a given storage room. Two variants in room ventilation were individually assumed: that the pure and contaminated air intermixed instantly, and that the pure air expelled the contaminated air, but did not mix with it. The formulas should be useful in designing safe working areas and storage conditions for radioactive substances (ores, concentrates, and salts) such as radium. (K.S.W.)

36645 DECREE OF 4 SEPTEMBER 1969 ON THE IMPLEMENTATION OF ARTICLES 16, 17, 19, (PARAGRAPH 1), AND 21 OF THE NUCLEAR ENERGY ACT (DECREE ON NUCLEAR INSTALLATIONS FUELS AND ORES). Staatsblad van het Koninkrijk der Nederlanden; No. 403, 909-27(9 Oct 1969). (In Dutch).

Directives regarding applications for authorization to set up nuclear installations or store nuclear fuel and ores are presented. The Decree also establishes the requirements to be satisfied for the issue of such authorizations (protection of humans, animals, vegetation and goods against ionizing radiation and radioactive contamination, etc.) (Occup. Safety and Health Abstr.)

Handling Equipment and Procedures

Refer also to abstracts 36044, 36112, 36633, and 36645.

36646 (RFP-1821) CALCULATIONAL STUDY OF ARRAYS OF CYLINDERS OF FISSILE SOLUTION. Dickinson, Deanne (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 24 Mar 1972. Contract AT(29-1)-1106. 12p. Dep. NTIS.

Values of k_{eff} for experimentally critical systems of enriched uranium or plutonium solution are calculated using the DTF-II, KENO, and KENO II computer codes. Both KENO and KENO II underestimate k_{eff} (effective neutron multiplication factor) for minimally reflected uranium-solution systems, indicating that some correction is needed if these codes are to be used conservatively in nuclear safety calculations. Calculated critical parameters are presented for line arrays of long cylinders of fissile solution reflected by Plexiglas or concrete. The reflector is a cuboidal shell, simulating a room, and the distance from the sides of the shell to the array is varied. Two examples of double-line arrays are presented. (auth)

Transportation

Refer also to abstracts 36638 and 36645.

36647 (DPST-59-205) SHIPPING CONTAINERS FOR ^{238}Pu. Proctor, J. F. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). 17 Feb 1959. Contract AT(07-2)-1. 13p. (SEP-N-5). Dep. NTIS.

Declassified 27 Oct 1971.

A set of design criteria is presented for ^{238}Pu shipping containers. The container is a corrosion-resistant pressure vessel with a minimum number of closures. All points of leakage of the primary container were enclosed within a secondary pressure vessel. Also, provisions were made for the following: inclusion of platinum within the primary container to act as a catalytic recombiner for gases produced by radiolysis of the solution; suitable radiation shielding, and reliable means for removal of decay heat; and adaptability of the container to currently accepted handling practices for Pu with respect to radiation and contamination hazards during loading and unloading. (P.C.H.)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 36694.

36648 (DNPL/R-13) DETAILED DESIGN STUDY FOR THE "NINA BOOSTER". VOLUME 1. Crowley-Milling, M. C. (Daresbury Nuclear Physics Lab. (England)). 1971. 202p. Dep. NTIS (U. S. Sales Only).

An outline of the results of the work carried out in a Design Study on alternatives for using the electron Synchrotron NINA as the injector for a higher energy ring is presented. Some aspects are covered by new theoretical work, and for others, prototype equipment was constructed and tested. Design was carried out in sufficient detail to obtain cost estimates reliable enough to allow a choice to be made on economic grounds where technically satisfactory alternatives existed. The subject is considered under the headings; site requirements and layout; magnet lattice and orbit calculations (magnet lattice, aperture requirements, tolerances, damping system); magnets and quadrupoles (magnets, quadrupoles, magnet and quadrupole supports); magnet power supply system (the "white" circuit, the magnet network, the magnet power supply, the flat top, the quadrupole network, control); the radio frequency system (general requirements, energy gain per turn, the choice of rf structure, rf power requirements, transverse modes, transient beam loading effects, the rf amplifiers); the vacuum system (the vacuum chamber, vacuum joints, the vacuum pumps, initial evacuation, control and indication); extraction from Nina and injection into the booster (extraction from Nina, transfer path, timing and tolerances); targetting and beam extraction; control and indication (system specification, system configuration, the CAMAC subcenters, the distributed multiplex system, the control center, communications and personnel safety, control of magnet position, beam position and intensity monitors); experimental requirements (apparatus, experimental hall, ancillary building, beam lines); building and civil engineering works (booster ring building, experimental hall, service buildings, mechanical services, electrical services, radiation protection and shielding); survey (site requirements, reference network, magnet and quadrupole position); timescale and manpower requirement (construction programme, magnet unit assembly, manpower requirements); and cost estimates (method of estimation, cost summary, cost of increase in energy, comparison with previous estimates). (UK)

36649 (ORNL-4720, pp 112-15) HPRR AND ACCELERATOR OPERATIONS. Haywood, F. F.; Banta, H. E.; Littleton, C. P.; Ward, D. R.; Poston, J. W.; Robinson, E. M. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

RADIATION DOSIMETERS—response of nuclear accident, intercomparison studies on, p. 112, 113
TRITIUM—design of self-replenishing targets of, p. 114, 115
VAN DE GRAAFF ACCELERATORS—operation of ORNL 3-MeV, p. 114 (R.C.K.)

36650 DIFFRACTION RADIATION OF CHARGED RINGS MOVING IN A CORRUGATED CYLINDRICAL PIPE. A MODEL OF RADIATION LOSSES IN AN ELECTRON RING ACCELERATOR. Keil, E. (CERN, Geneva). Nucl. Instrum. Methods; 100: No. 3, 419-27(1972).

The energy loss of a charged ring passing an infinitely long periodic sequence of rf accelerating cavities, which has recently received much attention in connection with the collective acceleration of ions in electron rings, is calculated by expanding the vector potential into a series of eigenfunctions of the empty waveguide and computing their individual excitation. The frequency spectra obtained are compared with the predictions of simpler analytical models from which a set of formulas for the practical design of rf accelerating structures for electron rings can be derived. The energy loss becomes independent of γ when the electron rings have a highly relativistic speed. (3 figures, 2 tables) (auth)

Auxiliaries and Components

Refer also to abstract 36622.

36651 (BNL-16789) THERMAL CONDUCTIVITY OF BRAIDED SUPERCONDUCTOR SYSTEMS. DeVito, B.; Jensen, J. E. (Brookhaven National Lab., Upton, N. Y.). 12 Jul 1971. 15p. Dep. NTIS.

The thermal conductivity of four braided superconductor systems for application to the design of superconducting dipole magnets was measured. The experimental apparatus and procedure are described, and the reduced thermal conductivity data measured both parallel and perpendicular to the width of the braided superconductor are given. A mathematical model using the solid conduction equation is presented for comparison. (W.H.K.)

36652 (CEA-N-1520) DIGITAL MEASUREMENT OF TIME PARAMETERS OF THE ELECTRON BEAM IN A LINEAR ACCELERATOR. Lemonnier, Jean-Claude; Roland, Sixte (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1972. 12p. (In French). Dep. NTIS (U. S. Sales Only).

A digital measurement system is described, which permits a visual display of the temporal half-width of an electron pulse and the delay of this pulse with respect to the initial time t_0 of the experiment. (France)

36653 (KFK-1354) ASPECTS OF A PULSED SUPERCONDUCTING BENDING MAGNET. Ries, G.; Juengst, K. P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Sep 1971. 16p. Dep. NTIS (U. S. Sales Only).

Various winding cross sections for generation of uniform fields in pulsed superconducting synchrotron magnets are described. For cooling, the insertion of vertical cooling channels in the winding cross section is proposed through which the coolant flows. It is shown that a dipole configuration with current return paths at the coil ends perpendicular to the magnet axis and longitudinal straight winding sections of equal length generates a $\int$Bdl constant over the aperture. These points are taken into account in a proposal for the coil design of a 50-kGauss bending magnet. The subdivision into coil packets and the fabrication of the single coils are described. (auth)

36654 (LNF-72/6) PRELIMINARY STUDY OF A SUPERCONDUCTING DIPOLE IN DIRECT CURRENT. Pasotti, G.; Spadoni, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 27 Jan 1972. 17p. (In Italian). Dep. NTIS (U. S. Sales Only).

Preliminary design studies were made on the development of a two-sector superconducting dipole with the maximum field of 30 kOe, magnetic length of 35 cm, free diameter of about 10 cm, probable utilization region of 7 cm, and transverse field uniformity of about 1%. The analysis suggests the advantage of simpler construction than the ellipse. Another advantage is the easier calculation of the spurious harmonic components and the field distortions. (J.S.R.)

36655 ELECTRON BEAM CURRENT MONITORING SYSTEM. II. Pruitt, J. S. (National Bureau of Standards, Washington, D. C.). Nucl. Instrum. Methods; 100: No. 3, 433-43(1972).

A reliable method for absolute calibration of a ferrite electron beam current monitor with a pulse generator was developed and tested. The absolute accuracy of pulser calibrations and Faraday cup calibrations of the National Bureau of Standards ferrite monitor were compared by using them both to determine the Faraday cup error. These independent determinations differ by a maximum of 0.11% and an average of 0.03% at six different energies in the 20 to 120 MeV range; beam currents between 0.6 and 25 μA were used. Variation of the Faraday cup error with energy is shown to compare favorably with the predictions of other authors, and the good agreement is used to argue that the influence of beam microstructure on the ferrite calibration is less than 0.1%. (11 figures, 2 tables) (auth)

36656 SIMPLE TIME-OF-FLIGHT METHOD TO MEASURE THE BEAM ENERGY OF A CYCLOTRON. Romero, J. L.; Massmann, H.; Brady, F. P.; Zamudio, J. (Univ. de Chile, Santiago). Nucl. Instrum. Methods; 100: No. 3, 551-2(1972).

A time-of-flight method which requires a single measurement was employed to measure the cyclotron beam energy to an absolute precision of at least 0.1% for 5-MeV deuterons. (2 figures) (auth)

36657 PRECISE MEASUREMENTS OF PEAK FIELDS OF PULSED QUADRUPOLE MAGNETS. Kobayashi, M.; Yamashita, S. (National Lab. for High Energy Physics, Oho-machi, Japan. Nara Women's Univ., Japan). Nucl. Instrum. Methods; 101: No. 2, 187-97(1972).

A peak-to-dc comparison method using search coil techniques and an oscilloscope was developed for measuring peak fields of pulsed magnets precisely. The emf induced in a search coil is integrated and the peak voltage of the integrated emf is measured by comparison with a dc reference voltage. For a pulse width as short as 1 ms, a relative measuring accuracy within 0.01% was obtained. This method was used to determine some peak field characters of drift tube quadrupole magnets for a 20 MeV proton linac. In the appendix is described the performance of another method, the reference pulse method, where the integrated emf is compared with a reference pulse. For the precise measurement of the peak field, automatic detection of the peak field timing is necessary in order to determine the comparison point. (auth)

36658 DESIGN AND SENSITIVITY OF A SECONDARY EMISSION MONITOR OF ACCELERATED ELECTRON BEAM POSITION. Prudnikov, I. A.; Toropov, A. S.; Chichikalov, Yu. F. (Efremov Scientific Research Inst., Leningrad). Nucl. Instrum. Methods; 101: No. 2, 275-7(1972).

The design and sensitivity of a secondary emission monitor of accelerated electron beam position are considered. The emitting electrode-foils are cut into two equal halves, in two mutually perpendicular directions. The monitor sensitivity, measured at two values of beam pulsed current, 50 and 100 mA appeared to be equal to 8.8 and 7.6 μA/mA mm respectively. At the given values of beam pulsed current the calculated sensitivity is respectively equal to 10.6 and 9.6 μA/mA mm. (auth)

36659 BETATRON. Ananiev, Lev Martemyanovich; Pekker, Yakov Semenovich; Chakhlov, Vladimir Lukyanovich; (and others) (to Tomsky Ordena Trudovogo Krasnogo Znameni Politekhnichesky Institut Imeni). British Patent 1,273,174. 3 May 1972. Filed 11 Aug 1969.

Reference is made to magnetic induction electron accelerators (betatrons) used for physical and biological studies, including flaw detection and medicine. In conventional betatrons the dc source for the electromagnet is protected against flow of the varying component of the magnetization current by an inductance or a filter in the dc circuit. This has the disadvantage of considerably increasing size and weight which sometimes restricts the field of application of the machine. The machine described includes a compensation transformer energized by the ac of the power supply with its secondary winding connected in series with the dc current source and in opposition to an ac magnetizing winding of the electromagnet, the windings carrying identical ac voltages in operation. Capacitors may be connected across the windings. (UK)

36660 MEASUREMENT AND MONITORING OF THE SPATIAL CHARACTERISTICS OF THE EXTERNAL BEAMS OF THE EREVAN RING ELECTRON ACCELERATOR. Arakelyan, G. A.; Vartanyan, G. S.; Esin, S. K.; (and others) (Erevan Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 996-8(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 46-8(Jul-Aug 1971).

Instruments are proposed which allow the magnitude of the current of charged particles extracted onto an internal target to be determined along with the vertical position of the electron beam at the instant of extraction and at the point of extraction. An instrument is also proposed which allows the position of the center of gravity of the γ beam to be determined. Methods are considered for using the information obtained to control the accelerator parameters during the ejection period. (auth)

36661 PICKUPS FOR SENSING THE POSITION OF A BEAM OF ACCELERATED ELECTRONS. Denyak, V. M.; Startsev, V. I.; Nemashkalo, A. A.; Ananiichuk, V. N. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 992-5(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 43-5(Jul-Aug 1971).

Pickups for sensing the position of a beam of accelerated electrons which operate according to the principle of a secondary-electron-emission monitor and according to the ionization-chamber principle are described. The advantages of the pickups lie in the possibilities of obtaining the required output characteristic, the independence of the output signal from the beam current, and the considerable simplification of the recording network. (auth)

36662 DISPLAY OF THE ENERGY SPECTRUM OF A BEAM OF CHARGED PARTICLES AT THE OUTPUT OF A LINEAR ION ACCELERATOR BY MEANS OF A TRANSPARENT INDUCTION PICKUP. Beznogikh, Yu. D.; Voevodin, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 999-1001(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 49-51(Jul-Aug 1971).

A method is described for the display and monitoring of the spectrum of a beam of charged particles at the output of a linear ion accelerator. The method is based on measuring the signal proportional to the amplitude of the K-th harmonic of the expansion of a periodic sequence of charged-particle bunches into a Fourier series. A cylindrical pickup electrode mounted on the drift section of the injection channel is used as a sensor. It is possible to obtain information on the energy spectrum during each acceleration cycle and without disrupting the mode of injection into the ring accelerator. (auth)

Ion Sources, Injection, and Extraction

Refer also to abstract 36288.

36663 (NP-19179) STUDY OF THE NEW CENTRAL REGION OF THE CERN SYNCHROCYCLOTRON. Comiti, S. (Universite Scientifique et Medicale de Grenoble (France). Faculte des Sciences). 1971. 92p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The new central region of the CERN synchrocyclotron is described beginning with results from the theory of the synchrocyclotron. The study of the sequence of the acceleration spaces and the radiofrequency extraction system makes it possible to define a confined central geometry with an optimum interval of initial phases. Mock-ups of the central geometry are then realized in order to obtain with precision the configuration of the electric field. The calculation of the trajectory is then made, first in the median plane and then in three dimensions by taking into account the effect of space charge. (J.S.R.)

36664 (RHEL/R-248) TRANSPARENT TOUCH-SCREEN DEVICE FOR INTERACTIVE COMPUTER-GRAPHICS DISPLAYS. Mott, E. M. (Rutherford High Energy Lab., Chilton (England)). Feb 1972. 13p. Dep. NTIS (U. S. Sales Only). UK 20 pence.

A unit is described which provides a simple and economic method of achieving operator interaction with a computer-graphic control system by only requiring the operator to touch the display screen. A system of intersecting light beams and detectors is used to identify the selected position. The equipment was designed to operate with a PDP-8 computer used principally to control an extracted motion beam line on the Nimrod Accelerator at the Rutherford High Energy Laboratory. (auth) (UK)

36665 500-kV IMPULSING GENERATOR. Pavlovskii, A. I.; Bosamykin, V. S.; Gerasimov, A. I.; Klement'ev, A. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1075-7(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 112-14(Jul-Aug 1971).

A 10-stage Arkad'ev-Marx generator is described having a coaxial discharge impulsing circuit with a maximum voltage of 500 kV; the generator serves as the power supply for a high-current electron gun. The inductance of the generator is 1.2 μH. The spark gap of the first stage is gas-filled ($N_2 \sim 5$ atm), while the subsequent spark gaps are air gaps: five trigatrons with automatic firing from the operation of the preceding stage, and four two-electrode spark gaps. The duration of the flat top of the output pulse is controlled by a cutoff spark gap. The time distribution of the breakdown of the spark gaps is given, as well as the dependence of the generator operating time on the number of trigatron spark gaps. (auth)

36666 FOCUSING ACTION OF MICROWAVE FIELDS ON A PARTICLE BEAM IN CYCLIC ACCELERATORS DURING CAPTURE INTO THE ACCELERATION MODE. Didenko, A. N.; Nepokrytykh, Yu. A. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 978-81(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 31-4(Jul-Aug 1971).

The results of an experimental investigation of the focusing action of electromagnetic waves belonging to the H_{11N} mode on an electron beam during capture into the acceleration mode are considered in closed ring cavities constructed using vacuum chambers of cyclic accelerators. It is shown that the microwave field considerably increases the beam-capture coefficient and increases the power of the radiation dose at the output. (auth)

36667 TWO-GAP ION BUNCHING AT THE INPUT OF A LINEAR ACCELERATOR. Beznogikh, Yu. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 986-8(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 38-41(Jul-Aug 1971).

The bunching of ions at the input of a linear accelerator by means of a two-gap buncher with a drift tube is discussed. As a result of a substantial reduction of the drift space the efficiency of the buncher is higher than that of a one-gap kylstron buncher at a high current of the bunched beam. The block diagram of a two-gap buncher combined with the accelerating structure of a linear ion accelerator is considered. Experimental results are presented for the operation of the combined buncher in a linear deuteron accelerator which serves as the injector of the synchrophasotron at the Joint Institute for Nuclear Research. (auth)

36668 ENERGY SCATTER OF IONS WHICH EXIT FROM HIGH-FREQUENCY SOURCES HAVING A SHIELDED DISCHARGE. Lavrov, V. M.; Shchemelinin, S. G. (Physical-Technical Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 989-91(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 41-3(Jul-Aug 1971).

The energy scatter and the mean energy of the ions exiting from high-frequency sources having shielded and unshielded discharges were determined. Sources of the transverse magnetic field and a probe system for ion extraction were investigated. It was revealed that the energy scatter of the ions depends on the magnetic field intensity. The shielding of the discharge made it possible to reduce the energy scatter of the ions by several tens down to 2.5 to 3.0 eV. Under these conditions the ion current at the output of the ion-optical system was $40\ \mu A$ for an accelerating voltage of 1.5 kV. (auth)

Ion Optics and Field Calculations

Refer also to abstract 36673.

36669 (CONF-690811-18) VARIATION OF POLARIZATION OF BEAMS OF PARTICLES IN CIRCULAR ACCELERATORS. Simonian, Kh. A. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). Translated by H. Polge (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires), from 7th International Conference on High Energy Accelerators, Moscow, August 28–September 2, 1969. 20p. (In French). Dep. NTIS (U. S. Sales Only).

A method for the determination of the variation of polarization of particle beams in circular accelerators is proposed which is applicable to all initial orientations of the $\vec{S}_i$ vectors. With it, calculations can be made taking into account all the effects which act on the spin movement during an acceleration cycle. The equation of Bargmann, Michel, and Telegdi is used in the mixed system of coordinates. For the system (R) (x′, y′, z′) a system was taken in which the axes at any moment are parallel to the corresponding axes of the system (L). (J.S.R.)

36670 (JINR-P9-6318) INFLUENCE OF METALLIC SURFACES ON THE STABILITY AND FOCUSING OF RELATIVISTIC ELECTRON RING. Bonch-Osmolovskii, A. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

The possibility of depressing the radiative instability and the focusing effects when compressing the relativistic electron ring in the vicinity of metallic surfaces are considered. The nature of the curvature effect on the effective index of the focusing field decay is discussed. (auth)

36671 EFFICIENCY OF OPERATION OF A SYSTEM FOR SUPPRESSING COHERENT PHASE OSCILLATIONS. Bondarev, B. I.; Murin, B. P.; Solov'ev, I. E. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 975-7(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 29-31(Jul-Aug 1971).

The longitudinal motion of protons in a linear accelerator is modeled on an electronic computer, and the Monte Carlo method is used to investigate the change in phase volume caused by the errors of fabricating and mounting the accelerating structure and by the fluctuations of the accelerating field. It is shown that the use of a system for suppressing coherent oscillations of particles substantially reduces the effective phase volume of a bunch. (auth)

36672 INVESTIGATION OF PARTICLE TRAJECTORIES FOR ACCELERATION IN A THREE-SECTOR CYCLOTRON MODEL WITH SEPARATE MAGNETS. Blokhin, V. T.; Katsaurov, L. N.; Matachun, A. T.; Moroz, E. M.; Nechaeva, L. P. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 982-5(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 34-8(Jul-Aug 1971).

The positions of the particle trajectories were measured for acceleration in the cyclotron of the Physics Institute, Academy of Sciences of the USSR, as a function of the initial injection conditions. Those initial injection conditions for which the trajectories of the accelerated particles are separated on all azimuths are found from the measured magnetic field using an electronic computer. The measured trajectory coincides with the trajectory calculated on the electronic computer and with the theoretical curve for a stepped field with an accuracy of several percent. (auth)

Storage Rings

Refer also to abstract 37076.

36673 (BNL-16794) DISPERSION IN CIRCULAR MACHINES. Claus, J. (Brookhaven National Lab., Upton, N. Y.). 27 Jul 1971. 2p. Dep. NTIS.

In circular accelerators or storage rings the equilibrium orbits for particles of different energies are physically different. This dispersion is a function of azimuthal position. The machine structure may be chosen either to keep its maximum value low by distributing it more or less uniformly around the ring or to produce areas where it is zero. In storage rings it may be of interest to have zero dispersion in some of the interaction areas because this increases the effective beam brightness. It is shown that the dispersion caused by any linear mirror symmetric system may be removed to first order by having a quadrupole of proper strength in the plane of symmetry. (W.H.K.)

36674 (BNL-16798) MEASUREMENT OF MULTIPLICITY AND ANGULAR DISTRIBUTIONS IN MULTIPARTICLE PRODUCTION AT ISABELLE. Ramanauskas, A. (Brookhaven National Lab., Upton, N. Y.). 19 Aug 1971. 6p. Dep. NTIS.

The design features of Isabell which are required to measure multiplicity and angular distributions in multiparticle production experiments are discussed. The experimental equipment and layout are considered. (J.F.P.)

36675 (BNL-16800) NOTES FROM A VISIT AT THE CERN ISR. Chasman, R. (Brookhaven National Lab., Upton, N. Y.). Aug 1971. 5p. Dep. NTIS.

The status of the CERN ISR is outlined. The ISR now runs at an energy of 25.5 GeV in both rings. The average pressure is down to 10^{-10} torr, and for low currents (below 2 A) the decay rate of the beams is better than 10^{-5}/min. Various problems are briefly discussed concerning high-intensity rf stacking and space charge effects. (W.H.K.)

36676 (BNL-16803) GAS SCATTERING IN THE ISA. Foley, K. J.; Love, W. A. (Brookhaven National Lab., Upton, N. Y.). 9 Sep 1971. 3p. Dep. NTIS.

Interactions of beam particles with residual gas in the vacuum chamber, which will be an important source of background in experiments to be performed at ISABELLE, are considered. Estimates of the background rate are presented, and the effect on small angle elastic scattering experiments is discussed. (W.H.K.)

36677 CERN COLLIDING PROTON BEAMS AFTER ONE YEAR OF OPERATION. Cocconi, G. Comments Nucl. Particle Phys.; 5: No. 2, 47-54(Mar-Apr 1972).

A short description is given of the CERN intersecting rings system that commenced operation in January 1971 with two colliding proton beams each of energy up to 27 GeV. This is followed by comments on the experimental program. To date, definite results have been obtained from two types of experiments; in one, the momentum spectra of stable and metastable secondaries were measured, while in the other p-p elastic scattering at small angles was investigated. Comparison of results with the predictions of various models is made. Among other things, it is stated that a characteristic of the high energies made available by the ISR would be the production of quarks or of partons. New research possibilities will be made available when a large split-field magnet commences operation in 1973. Some of the intricacies of hadron physics can be revealed only by the detailed analysis of each interaction. Some disadvantages of the colliding beam technique are briefly discussed. (16 references.) (UK)

36678 EQUIPMENT FOR TOTAL AND PARTIAL PRESSURE MEASUREMENTS IN THE ISR ULTRA-HIGH VACUUM SYSTEM. Angerth, B. (CERN, Geneva). Vacuum; 22: No. 1, 7-14 (Jan 1972).

Over 500 low-pressure gauges were needed for monitoring total pressures in the ultra-high vacuum system of the CERN Intersecting Storage Rings for protons (ISR). For analysis of the gas composition 30 residual gas analyzers were required. About 200 total pressure gauges of different types were included to provide detailed information on the pressures during the rough pumping process. The technical specifications for the different instruments are discussed. Some difficulties, which limited the performance at an early stage, are mentioned. Results of the acceptance tests on instruments delivered to CERN are presented. Procedures for total and partial pressure measurements in the ISR are reviewed, and the performance of the instruments after final installation is discussed. (auth)

Experimental Facilities

Refer also to abstracts 36139, 36203, and 36649.

36679 (AECD/EP–26) CHARGED PARTICLE ENERGY AND N.M.R. FREQUENCY FROM NEUTRON ENERGY INCORPORATING ENERGY LOSS IN TARGET. Enayet Ullah, M. (Atomic Energy Centre, Dacca (Pakistan)). Nov 1971. 99p. Dep. NTIS (U. S. Sales Only).

Tables of charged particle energy and N.M.R. frequency from Neutron Energy taking into account the energy loss in target by the charged particle are given for 22 target thickness ranging from 0.1 mg to 7.8 mg. The neutron energy range covered is from 0.260 MeV to 2.200 MeV at 10 keV intervals obtained from the $T(p,n)^3He$ reaction at 0° only. (auth)

36680 (ANL/HEP–7208(Vol.1), pp 113-24) AVAILABLE BEAMS AT THE ZGS. Schweingruber, F. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The beams at the ZGS EPB-1 and EPB-2 experimental areas and the internal target are described. Expected π^+, π^-, K^+, and K^- yields from $2 \times 10''$ protons incident on a 4 inch beryllium target are graphed. (W.H.K.)

36681 (ANL/HEP–7208(Vol.1), pp 202-12) EXPERIMENTS PROPOSED FOR LAMPF. Burman, R. L. (Los Alamos Scientific Lab., N. Mex.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The design of experimental facilities and beams for LAMPF are briefly described. The various experiments proposed include nuclear structure and chemistry and strong, electromagnetic, and weak interactions. (J.F.P.)

36682 (ANL/HEP–7208(Vol.2), pp 531-44) BACKWARD MESON PRODUCTION IN THE ILLINOIS-ZGS STREAMER CHAMBER. Buttram, M. (Illinois Univ., Urbana). 1971. (COO-1195-219).

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The ZGS streamer chamber facility is described which is currently being tested by a group from the University of Illinois in cooperation with Argonne National Laboratory. The facility was built as part of the backward meson production experiment E297 with the understanding that at the completion of that experiment the chamber would become available to Argonne users as a facility. Hopefully, chamber operation will begin this winter and E297 will be completed about one year later, allowing for a six-month shutdown. Some of the useful properties of streamer chambers in general and of this facility in particular are described, and the experimental program planned for the ZGS chamber by the University of Illinois group is briefly discussed. (auth)

36683 (ANL/HEP–7208(Vol.3), pp 785-7) RF BEAM FOR THE 12' CHAMBER. Wangler, Thomas P. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The properties of the beam are given. The operating points at the 32 m drift length for $K^{\pm}$ and $\bar{p}$ beams are tabulated, as well as the beams obtainable if the drift length is varied. (3 tables) (R.W.R.)

36684 (ANL/HEP–7208(Vol.3), pp 988-97) SOME CONSIDERATIONS OF PROVIDING STOPPING K^-, $\bar{p}$ BEAMS. Spirn, I. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Beam 47 is a low-momentum, separated beam designed to deliver a large flux of kaons or antiprotons to the 12-ft bubble chamber. Estimated yields per 10^{11} p on targets are 120 K^+, 25K^-, and 40 $\bar{p}$. The physical setup for producing this beam is described, and some of the beam parameters are given. (6 figures, 1 table) (R.W.R.)

36685 (ANL/HEP–7208(Vol.3), pp 1006-12) TRAVELING WAVE INTERMEDIATE ENERGY BEAM. Klem, R. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The principles of a traveling wave separator are first discussed. It consists of an rf structure with the phase velocity adjustable by dielectric loading to be synchronized with the wanted particle. In this way separation can be achieved in a single stage. The equipment necessary to produce a beam of charged kaons or antiprotons is considered, along with the properties of the resulting beam. (1 figure, 2 tables) (R.W.R.)

36686 (ANL/HEP–7208(Vol.3), pp 1084-93) POLARIZED PROTON TARGETS AT THE ZGS. Hill, Daniel A. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A general description is given of the two current polarized proton targets at the ZGS, PPT-II and PPT-III. PPT-II and an additional system, PPT-III Prototype, are operational. Some results from the prototype are given. (14 figures, 2 tables) (R.W.R.)

36687 (ANL/HEP–7208(Vol.3), pp 1094-1111) SUPERCONDUCTING MAGNET FOR PPT-III. Desportes, H. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The relative merits of conventional and superconducting magnets for systems such as the PPT-III are first discussed. The design, fabrication, and testing of PPT-III are then described in detail. (9 figures, 1 table) (R.W.R.)

36688 (ANL/HEP–7208(Vol.3), pp 1122-3) POLARIZED PROTON BEAM AT THE ZGS. Moffett, R. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A proposed polarized proton beam is outlined. The ion source is briefly described. The principal problem in acceleration is depolarization of the beam. Characteristics of the extracted beam are given. Considerations in experimental area operation are sketched. (R.W.R.)

36689 (EUR–4404(Pt.3)) IBM 1800 PROGRAMS FOR DATA PROCESSING AT THE ACCELERATORS OF THE CENTRAL BUREAU FOR NUCLEAR MEASUREMENTS. PART 3. PROGRAMS FOR INTERACTIVE DATA REDUCTION. Horstmann, H. (European Communities, Brussels (Belgium). Commission. European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau). Mar 1972. 112p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 150.-.

A set of IBM 1800 interrupt servicing programs for interactive data reduction at the Van de Graaff and the electron linear accelerator of the Central Bureau for Nuclear Measurements is described. Most of the data to be processed are neutron cross section data collected in time-of-flight multi-channel analyzers which are interfaced to an IBM 1800. The experimental data are transferred to the disk storage of the computer on interrupt requests from the analyzers. The data reduction procedures described are initiated at the analyzer computer interface units by push-button and data entry switches. Typical operations are: subtraction of background data, retransmission of disk data to an analyzer for examination on a display unit, integration of count rates between channel limits, normalization of spectra; examination of available disk storage, deleting of disk data, orders for the computer operator, etc. All programs are written in ASSEMBLER language for the Time-Sharing Executive System (TSX). (auth) (EURATOM)

36690 (JEN-218-DF/I-62) 150-keV ACCELERATOR AS SOURCE OF PULSED NEUTRON. Cordero, F. (Junta de Energia Nuclear, Madrid (Spain)). 1970. 127p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The design of a Cockcroft–Walton 150-keV accelerator constructed at the J.E.N. is described. Beam currents of more than 10 mamp with the intensity of the neutron source of 10^{11} neutrons/sec can be obtained. The studies made in connection with the design are reported. The influence of contamination and the pumping of hydrogen on the performance of the pumps and gauges were studied in the vacuum system. Sinusoidal pulses were used for the method for the analysis of the discharge in the ion source and for the extraction and focusing of the ion beam. The optical system with the Gaussian approximation is calculated. Results of studies of the mean life of the T–Ti targets and the efficiency of different types of blanks are presented. The results obtained on the yield of neutrons from blanks self-formed on the carbon produced by the cracking of hydrocarbon vapors are given. (J.S.R.)

36691 100 MeV ELECTRON SCATTERING FACILITY AT THE UNIVERSITY OF GLASGOW. Hogg, G. R.; Slight, A. G.;

Drake, T. E.; Johnston, A.; Bishop, G. R. (Kelvin Lab., Glasgow). Nucl. Instrum. Methods; 101: No. 2, 203-19(1972).

The commissioning of a facility for the detection of scattered electrons, with energies up to 125 MeV, is described. A final resolution of about 0.12% with an overall stability of approximately 0.01% was achieved. The background count rate measured in a multichannel scintillation detector was 1 count per mC of incident beam per channel and the maximum scattering angle was 155°. (auth)

36692 SIMPLE MULTICOUNTER SYSTEM FOR SILICON DETECTORS. Kilian, K.; Niewisch, J.; Fick, D. (Univ., Erlangen, Ger.). Nucl. Instrum. Methods; 101: No. 2, 359-61(1972).

A time-saving, precise and simple multicounter system was built for use in a conventional scattering-chamber. The mechanical system is described and also some topics concerning the surface barrier detectors. (auth)

36693 50 cm. LIQUID HYDROGEN TARGET WITH LAWSONITE WINDOWS. Borzunov, Y. T.; Golvanov, L. B.; Mazarskii, V. L.; Tsviner, A. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Cryogenics; 12: No. 3, 235-6(Jun 1972).

In order to reduce the operating noise in liquid H_2 targets the amount of material in the beam entrance and exit windows should be minimal, and it has been found that Lawsonite is a good material for target windows. This material is strong, keeps its elasticity at low temperatures, and has low density and small Z. A target vessel employing this material is described. (UK)

36694 DARESBURY DIVERSIFIES. Stubbs, P. New Sci.; 54: No. 797, 435-41(25 May 1972).

Some of the present and proposed work at Daresbury Nuclear Physics Laboratory is described and discussed. The new Synchrotron Radiation Facility (SRF) utilizes the intense electromagnetic radiation from NINA, the 5-GeV electron synchrotron, and consists of a pair of accurately tangential, 170-foot-long beam lines connecting with the circular vacuum vessel of NINA via ports and directing the radiation to the new 30-foot by 75-foot experimental laboratory. The acceleration forces imposed upon the electrons by the magnet ring which steers them on their path cause them to emit intense radiation varying in wavelength from a fraction of an angstrom to the visible part of the spectrum. This spectrum varies according to the beam energy but peaks in the x-ray region around 1 angstrom. In practice the useful spectrum extends from a few angstroms to about 3000 angstroms in the near ultraviolet. Within the experimental area each beam passes through two grating monochromators, one normal incidence and one grazing incidence, to select the wavelength which the experimenter desires. The experimental program, which is to be undertaken by teams from a number of centers, is outlined. This facility is particularly valuable for studying the fast processes in atoms and molecules that take place upon irradiation, especially the transitional energy states accompanying photo-chemical changes. The proposed 20- to 30-MeV tandem generator is also described. This machine will be able to accelerate ions from hydrogen up to uranium in mass and will be housed in a 200-ft-high tower. (UK)

36695 LIQUID-HYDROGEN MYLAR TARGET HAVING THIN MYLAR SIDEWALLS. Vasil'ev, L. M.; Radkevich, I. A.; Smolyankina, T. G.; Sokolovskii, V. V. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1008-9(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 56-7(Jul-Aug 1971).

A liquid-hydrogen target having a vacuum housing of small size which constitutes a metallic frame with Mylar glued onto it on all sides is described. The target is designed to investigate reactions with emission of slow charged particles. (auth)

36696 REMOTE CONTROL OF TARGETS. Khurshudyan, L. S.; Agan'yants, A. O. (Erevan Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1010-12(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 57-9(Jul-Aug 1971).

A simple device is described for remote control of targets mounted on a common movable frame, by means of which the direction of motion of the target and its fixing in a stipulated position can be carried out automatically. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 36161, 36162, 36164, 36236–36245, 36247–36262, 36814, 36959–36966, 36973–36976, 36978, 36981–37034, 37036, 37046, 37048–37065, 37067–37069, 37077, 37078, 37080–37086, 37088, 37090, 37092–37099, 37101, 37102, 37130, 37145, 37176, 37178, 37180–37191, 37193, 37194, 37221, 37222, 37240, 37241, 37288–37290, and 37420.

36697 (AECL–4077) COSMIC RAY MT-64 MUON MONITOR DATA. V. From Solar Rotation 1853 to Rotation 1866 (January 4, 1969–January 16, 1970). Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jan 1972. 102p. Dep. NTIS (U. S. Sales Only). AECL $2.00.

Hourly rates corrected for atmospheric temperature and pressure from four cosmic-ray stations in Canada which have muon monitors maintained by AECL and from a survey monitor stationed at Kula, Hawaii, are given in tabular form by solar rotation for the period from the beginning of Rotation 1853 to the end of Rotation 1866 (January 4, 1969, to January 16, 1970). The Dorman–Maeda temperature correction factors for each station calculated at 12-hour intervals from the radiosonde data of the Canadian Meteorological Branch or the US Weather Bureau are also listed. Barometric pressures are available from neutron monitor data reports already published. Graphs of the relative hourly rates at each station are given. (auth)

36698 (AECL–4148) COSMIC RAY NM-64 NEUTRON MONITOR DATA. XX. Monthly Graphs, September–December 1971. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Mar 1972. 68p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from September to December 1971. Normalized graphs are given for the same period. Correction factors for the constant rates of drift of the barometers at each of the four stations are given. A correction in the previously published results for Alert for December 31, 1970, is included. The results of the flare increase, which occurred on September 1–2, 1971, were published in the last report, AECL-4060. (auth)

36699 (AECL–4149) COSMIC RAY IGY NEUTRON MONITOR DATA. II. Monthly Graphs, January 1959–December 1959. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Mar 1972. 55p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

Uncorrected and barometer-corrected hourly rates from Deep River are given in tabular form for the period from January 1959 to December 1959. The barometer-corrected data are normalized to remove the effects of changes of efficiency and are compatible with the results of the 48-NM-64 monitor. Graphs of the corrected data are given. (auth)

36700 TRANSITION RADIATION AS A SOURCE OF COSMIC X RAYS. Ramaty, R. (Goddard Space Flight Center, Greenbelt, Md.); Bleach, R. D. Astrophys. Lett.; 11: No. 1, 35-6(May 1972).

Transition radiation generated during the passage of relativistic charged particles through interstellar grains can produce x rays up to energies $E_{max}(eV) \sim 1500\ a(\mu)$, where a is the diameter of a grain. For grain diameters smaller than several tenths of a micron, the x-ray yield above about 1 keV will be strongly reduced. In order to account for recent x-ray observations below 300 eV by transition radiation, an energy density in interstellar space of about 10 eV cm^{-3} in 10-MeV electrons is required. This seems to rule out transition radiation as an important source of diffuse cosmic x rays in any energy region. (auth)

36701 PERSISTENCE OF A SEMI-DIURNAL LUNAR VARIATION OF COSMIC RAY INTENSITY. Louvel, M.; Mosrin, P.; Osmont, A.; (and others) (Univ., Caen, France). Lett. Nuovo Cim.; 2: No. 26, 1346-8(25 Dec 1971). (In French).

Results obtained from three experiments on recording of cosmic rays, two at the bottom of an iron mine and the third at ground level, were compared to determine possible persistence of solar, sidereal, or lunar effects, diurnal for the first two and semidiurnal for the third. There appeared no significant variations on the histograms constructed in solar time. The diurnal sidereal and lunar periods gave contradictory results. The three experiments seemed in agreement on the presence of a semidiurnal lunar effect with a period of 745.236 min. The amplitudes in the last two experiments were 0.057 ± 0.015 and 0.036 ± 0.011, respectively. The amplitude in the first experiment appeared overestimated. Possible physical causes generating the semidiurnal lunar variation are suggested. (J.S.R.)

36702 LIMITING FRAGMENTATION AND THE CHARGE RATIO OF COSMIC-RAY MUONS. Frazer, W. R. (Univ. of California, La Jolla); Poon, C. H.; Silverman, Dennis; Yesian, Harry J. Phys. Rev., D; 5: No. 7, 1653-7(1 Apr 1972).

Combining the steeply falling primary cosmic-ray spectrum with the scaling hypothesis for the spectrum of produced secondary particles, it is illustrated how to correlate data at machine energies with cosmic-ray phenomena. It is found that the μ^+/μ^- ratio is expected to be energy-independent and greater than 1, regardless of the specific model chosen for multiparticle hadronic reactions. An analysis of accelerator data gives the value $\mu^+/\mu^- \approx 1.56$, to be compared with the experimental result ~1.25. Possible causes of this discrepancy are discussed. (auth)

36703 PROCEEDINGS OF THE 11th INTERNATIONAL CONFERENCE ON COSMIC RAYS. VOLUME 4. MUONS AND NEUTRINOS: TECHNIQUES. Conference Held at Budapest, August 25–September 4, 1969. Somogyi, A. (ed.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 1-607(1970). (CONF-690814–(Vol.4)).

Separate abstracts were prepared for 94 of the 96 papers presented. Two papers appeared previously in NSA; see NSA 23: 43592 and 24: 26367. Volumes I, II, and III appeared in previous issues of NSA. (W.D.M.)

For abstracts of individual papers see: 36159–36164, 36236–36262, 36704–36730, 36959, 36973–36978, 37048–37069, 37077, 37078, 37168, 37221, and 37222.

36704 CHANGES OF RIGIDITY DEPENDENCE AND DAILY VARIATION DURING COSMIC-RAY DECREASES. Oestman, B.; Awadalla, E. (Inst. of Physics, Uppsala). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 7-11(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The drop in cosmic-ray intensity after a Forbush decrease was studied using an exponential curve describing the recovery. The curve gives an accurate determination of the drop in the intensity as a mean for a period of the recovery. The cosmic-ray decreases occurring from August 1957 to December 1959 were studied. The decreases were divided into three groups determined by the rate of the onset thereby giving consideration to the fact that the recovery rate is constant for some decreases and not constant for others. The three groups, swift, intermediate and slow decreases, were studied for variations of rigidity dependence. (auth)

36705 MUON SPECTRA IN VERTICAL DIRECTION IN ENERGY RANGE 30 TO 800 GeV. Allkofer, O. C.; Carstensen, K.; Dau, W. D.; (and others) (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 13-18(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The vertical muon spectra and the charge ratio in the energy range 30 to 800 GeV were measured at sea level with the Kiel cosmic-ray spectrometer. The integral intensity of muons with an energy greater than 116 GeV/c was found to be (8.85 ± 0.95) × $10^{-6}\ cm^{-2}\ sec^{-1}\ sr^{-1}$. The charge ratio seems to decrease with increasing energy. (auth)

36706 CHARGE RATIO AND MOMENTUM SPECTRUM OF COSMIC-RAY MUONS AT LARGE ZENITH ANGLES. Kamiya, Y.; Kawaguchi, S.; Fujii, Z.; Iida, S.; Mitsui, K. (Nagoya Univ., Japan). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 25-31(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A large-aperture and high-resolution cosmic-ray momentum spectrograph was constructed (The Nagoya Cosmic Ray Spectrograph No. 2). Using this apparatus, further observations of the energy dependence of the cosmic-ray muon charge ratio at large zenith angles were made. It was found that: (i) the sea-level cosmic-ray muon charge ratio is approximately constant over the wide range from 10 to 1000 GeV/c; (ii) a slight decrease around 80 GeV/c in production is indicated but is not so remarkable as was the previous result; (iii) two models of ultrahigh-energy nuclear collision, the H-quantum model and the Aleph model, were compared with the present experiment; and (iv) the momentum spectra of sea-level cosmic rays were derived at large zenith angles, and they were in agreement with those measured by Ashton, et. al. There seemed to be no evidence to support the hypothesis of direct muon production. (auth)

36707 INTENSITY MEASUREMENTS OF COSMIC RAYS IN WATER AT LARGE DEPTHS. Davitaev, L. N.; Fedorov, V. M.; Trubkin, Yu. A.; Vavilov, Yu. N. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 53-8(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
The intensity of muons at different depths in water was measured by means of a Cherenkov counter. The data obtained were compared with vertical muon intensity change curves calculated on the basis of several assumptions on the integral muon spectrum at sea level. (auth)

36708 HIGH-ENERGY MUON FLUX UP TO 8 TeV AT SEA LEVEL DERIVED FROM THE OBSERVED BURST SIZE SPECTRUM. Chin, S. (Osaka City Univ.); Hanayama, Y.; Hara, T.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 65-72 (1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Bursts produced by high-energy muons in rock were observed at a depth of 40 mwe underground by means of two layers of scintillators 20 m^2 in area and 2.43 m apart. The size distribution of bursts with several hundreds to 12,000 relativistic particles was obtained during an observing time of 17,700 hours. The energy spectrum of muons up to 8 TeV was derived from the burst-size distribution by using the Kobayakawa and Miono formula for the fluctuation of the cascade shower. Other formulae for the fluctuation are also discussed. (auth)

36709 ENERGY LOSSES AND THE ABSORPTION CURVE OF MUONS. Kotov, Yu. D.; Logunov, V. M. (Moscow Engineering Physics Inst.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 73-9 (1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Various kinds of energy losses of muons are discussed. The results of the calculations of the muon ranges in water and in media with $Z = 10$ to 13 are presented, and compared with experimental data. (auth)

36710 MOMENTUM SPECTRUM OF MUONS MEASURED BY THE DURGAPUR COSMIC-RAY SPECTROGRAPH. Nandi, B. C.; Sinha, M. S. (Regional Engineering Coll., Durgapur, India). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 87-90(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Preliminary data on the measurement of the momentum spectrum of muons are presented. The results are based on the analysis of 2492 single muons in an operating time of 168.7 hours of the spectrograph. The momentum spectrum at sea level (12°N geomagnetic latitude) measured by the Durgapur spectrograph refers to nearly vertically incident muons, both positive and negative, in the momentum range $4\ GeV/c < p < 834\ GeV/c$. (auth)

36711 INTERACTION OF MUONS IN SUBSTANCES OF HIGH Z IN THE ENERGY RANGE 10^{11} eV. Bibilashvili, M. F. (Inst. of Physics, Tbilisi, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 91-4(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
In 1965 a new method of studying muons of high energies, the so-called "spark calorimeter," was worked out and developed. Using this method a number of studies of muons were made. In particular, information was obtained on the spectrum of small bursts produced by muons in the calorimeter substance. The process of muon passage through the spark calorimeter was simulated by means of the Monte Carlo method with the aim of finding the relation between the burst spectrum and the energy spectrum of muons. The calculations were carried out by means of the computer M 20. (auth)

36712 SOME PECULIARITIES OF GROUPS OF PENETRATING PARTICLES OF HIGH ENERGIES. Bibilashvili, M. F.; Barnaveli, T. T.; Grubelashvili, G. A.; Muradova, N. A.; Khaldeeva, I. V. (Inst. of Physics, Tbilisi, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 95-7(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Analyzing the data obtained with spark calorimeters, some interesting peculiarities were found in the energy characteristics of the groups consisting of muons. The groups consisting of 3 muons have a burst frequency distribution markedly different from that of larger groups. (auth)

36713 SEA-LEVEL MUON SPECTRUM AT 80^0 TO THE VERTICAL UP TO 1 TeV. Flint, R. W.; Nash, W. F. (Univ. of Nottingham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 95-105(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Measurements of the muon sea-level differential energy spectrum at 80° to the vertical were extended to 1 TeV using the Nottingham 80° spectrometer. Comparison of the intensities at 80° with those in the vertical direction indicated no deviation from the sec θ enhancement expected on kaon or pion parentage of the muon. The results were in agreement with $K/\pi \approx 0.4$ over the range considered. (auth)

36714 STUDY OF THE HIGH-ENERGY PENETRATING COMPONENT OF COSMIC RADIATION AT MOUNTAIN LEVEL. Erlykin, A. D.; Kulichenko, A. K.; Nikolskii, S. I. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 133-8(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Characteristics of cascades produced in the underground ionization calorimeter at Tien–Shan were studied. The results obtained were used to analyze the angular distribution and the energy spectrum of high-energy muons. (auth)

36715 ENERGY DEPENDENCE OF HORIZONTALLY INCIDENT ATMOSPHERIC MUONS. Maeda, K. (Goddard Space Flight Center, Greenbelt, Md.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 139-49(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Horizontally incident atmospheric muons and their parent particles travel one of the longest paths in the Earth's atmosphere, leading to the largest possible atmospheric effects on the muon production process. Diffusion equations for cosmic-ray mesons in the atmosphere are inadequate to treat these effects at a large zenithal direction. The calculation is, therefore, made by modifying the Chapman function for the nonisothermal atmosphere, and computations are also applied to a mountain altitude, specifically for the laboratory at Mt. Chacaltaya (5200 m). Results indicate: (1) the direction of the maximum muon intensity shifts from vertical at low energy to a zenith angle of 70° around 100 GeV at sea level (80° at the mountain altitude), and approaches the horizontal direction at high energies; (2) these zenith angles of maximum intensity are larger at a mountain altitude than at sea level; (3) these angles are also larger for pion-produced muons than for kaon-produced muons, and decrease with increase of the nuclear absorption mean free path of these muon-producing mesons; and (4) at extremely high energies, these are almost independent of the nature of cosmic-ray mesons but mostly dependent on the atmospheric structure. (auth)

36716 ZENITH-ANGLE DISTRIBUTION OF EXTREMELY HIGH-ENERGY MUONS ($\geq 10^{12}$ eV) OBSERVED WITH AN EMULSION CHAMBER. Misaki, A. (Saitama Univ., Urawa, Japan); Mizutani, K.; Ogata, T.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 167-74(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
The zenith-angle distribution of bremsstrahlung showers from extremely high-energy muons was observed with an emulsion chamber. The results provided information on the zenith-angle distribution of muons at an energy of about 1 TeV. These results were not inconsistent with that expected for muons from pion and/or kaon decay. (auth)

36717 STUDY OF ANGULAR DISTRIBUTION OF HIGH-ENERGY COSMIC-RAY MUONS AT LARGE ZENITH ANGLES. Borog, V. V.; Chernyatin, V. K.; Kirillov-Ugryumov, V. G.; (and others) (Moscow Engineering Physics Inst.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 179-82(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Preliminary results of a measurement of the zenith-angle distribution of high-energy muons incident at sea level at large zenith angles are presented. These results were obtained by means of an ionization calorimeter operating for 4000 hours in the period from October, 1968 to May, 1969. The experimental apparatus recorded the electromagnetic cascade showers produced by muons in the interval of zenith angles 50 to 90°. A comparison of experimental data with calculations showed that the angular distribution of cosmic-ray muons at energies above 10^{12} eV is anisotropic. (auth)

36718 ZENITH-ANGLE DISTRIBUTION OF ULTRAHIGH-ENERGY MUONS. Keuffel, J. W.; Osborne, J. L.; Bolingbroke, G. L.; (and others) (Univ. of Utah, Salt Lake City). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 183-91(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
The intensity of muons was studied as a function of zenith angle at fixed slant depth of rock. Detailed studies of the uniformity of the rock and of the detector efficiencies showed that there are no errors from these sources large enough to affect the angular dependence significantly. The results confirmed an earlier conclusion that direct muon production process does exist at about the 2% level. (auth)

36719 RE-EXAMINATION OF THE ANOMALOUS ZENITHAL DISTRIBUTION OF ATMOSPHERIC MUONS. Maeda, K. (Goddard Space Flight Center, Greenbelt, Md.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 193-7(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
An examination of the data from the Utah neutrino detector indicated the presence of internal inconsistencies. This is shown by making comparisons among in situ data only, instead of referring them to the world survey data. The X process proposed by Bergeson et al. seems, therefore, weakly based, if not unsubstantiated. (auth)

36720 CHARGE RATIO OF ULTRAHIGH-ENERGY MUONS. Parker, J. H.; Keuffel, J. W.; Bergeson, H. E.; Larson, M. O.; Lowe, G. H. (Univ. of Utah, Salt Lake City). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 199-202(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Using the University of Utah neutrino detector, which has the advantage of observing relatively low-energy muons that had enormous energies at production, the charge ratio of muons with production energies greater than 1 TeV (a decade higher than previously published results) was found to range from 1.28 ± 0.05 for the lowest energy data point to 1.05 ± 0.14 for the highest. This introduces a constraint which any proposed muon production mechanism must satisfy. (auth)

36721 LATERAL DISTRIBUTION OF MUONS UNDERGROUND. Coats, R. B.; Keuffel, J. W.; Stenerson, R. O.; (and others) (Univ. of Utah, Salt Lake City). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 205-7(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
The radial extent of muon showers underground was studied by measuring the separations between 3383 pairs of muons observed. The results are presented in the form of a decoherence curve which is compared to the theoretical predictions of Adcock, Wdowczyk, and Wolfendale. This comparison indicates that the mean transverse momentum of these shower muons is between 0.6 and 1.0 GeV/c. (auth)

36722 OBSERVATIONS OF COSMIC-RAY MUONS IN THE MONT BLANC TUNNEL. Sheldon, W. R. (Univ. of Houston, Tex.); Cantrell, W. G.; Duller, N. M.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 209-14(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Initial results are presented of a joint French–US experiment to measure the underground muon intensity in the Mont Blanc tunnel. The apparatus and experimental site are described. Results reported include a vertical intensity at 870 hg/cm^2, in good agreement with other results, and an intensity measurement for a zenith angle of 63° at a slant depth of 3060 hg/cm^2, somewhat less than twice the vertical intensity at the same depth. (auth)

36723 RECENT OBSERVATIONS ON THE ANGULAR DISTRIBUTION OF COSMIC RAYS UNDERGROUND AT 754, 1500, AND 3375 hg/cm^2 (KOLAR). Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 221-6(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
The vertical intensity and angular distribution of atmospheric muons were obtained from observations, using scintillator-neon flash tube telescopes, at three depths of 754, 1500, and 3375 hg/cm^2 (Kolar) in the Kolar Gold Mines in South India. The angular distributions obtained at the three depths were compared with those to be expected on the basis of the currently accepted vertical intensity vs. depth curve and several models that have been proposed concerning the parents of atmospheric muons. The observations were consistent with the picture that muons with energies up to several TeV are produced wholly through the decays of pions and kaons; no evidence was found for a new production process as postulated by the Utah group. On this basis, the angular distribution at 754 hg/cm^2 was compared with that at 1500 hg/cm^2 in the overlapping region to obtain the K/π ratio at production as 0.3 ± 0.2 at muon energies of the order of 500 GeV. (auth)

36724 EVIDENCE FOR ANISOTROPY IN THE COSMIC-RAY SIGNAL. Ryan, D. F. (State University Coll., Plattsburgh, N. Y.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 233-8(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Evidence for the existence of an anisotropy in the cosmic rays centered around 0900h sidereal time and +45° declination is described. (auth)

36725 MUON CHARGE-RATIO MEASUREMENTS AT LARGE ZENITH ANGLES UP TO 1 TeV. Flint, R. W.; Nash, W. F. (Univ. of Nottingham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 263-8(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
The energy dependence of the muon charge ratio at large zenith angles was studied in an experiment with the Nottingham 80° spectrometer. Over 25,000 single particle events were analyzed, and the results demonstrated the near constancy of the charge ratio over the muon production energy range 20 to 500 GeV. A possible fall in the charge ratio was apparent at ~1000 GeV. The data obtained from this experiment were combined with other pertinent data and studied with reference to the production of the muons. (auth)

36726 FINE STRUCTURE IN MUON CHARGE RATIO AT LARGE ZENITH ANGLES. Alexander, D.; Thompson, M. G. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 269-72(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Recent results from the Durham spectrograph, in the zenith range 80 to 90°, were not consistent with previous ones, there being a peaking in the muon charge ratio at mean muon sea level energies of 20 GeV as suggested by Kelly et al. The results, however, taken together with those results from the experiment reported by MacKeown, et al. did indicate a significant positive excess rising to a maximum at a mean muon production energy of 70 GeV in this zenith range only. (auth)

36727 ANOMALOUS INCREASE IN ENERGY LOSS OF HIGHLY RELATIVISTIC PARTICLES. Alexander, D.; Thompson, M. G. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 273-6(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
Recent experiments on the ionization energy loss of highly relativistic particles in phosphor Ne 102a indicated a possible rise of some (11.0 ± 0.6)% in the energy loss over the range of γ = 50 to 500 (γ = p/mc) where it should be constant. The results reported herein, although showing a small increase of (3.0 ± 2.7)% over the same range of γ, did not support the suggestion of an 11% increase. A χ^2 examination of the data showed that the probability of it being the consequence of a straight line relationship with slope 11% is 0.35%, while the probability of it being a consequence of a straight line relationship of zero slope was 72%. (auth)

36728 ENERGY SPECTRA OF COSMIC-RAY-MUON NEUTRINOS AT LOW ENERGIES. Tam, A. C.; Young, E. C. M. (Univ. of Hong Kong). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 307-12(1970).
From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).
The energy spectra of cosmic-ray-muon neutrinos for energies from a few GeV down to 0.2 GeV at sea level were calculated for vertical and horizontal directions. The effects of the geomagnetic cutoff of primary cosmic rays on these spectra at various geomagnetic latitudes were also estimated. The expected energy spectra of neutrino-induced muons underground were derived for the elastic and the inelastic neutrino interactions. It was found that from the geomagnetic latitude of 50°N to the geomagnetic equator, the differential intensity of neutrino-induced muons at 0.2 GeV decreases by 20%. (auth)

36729 POINT SOURCES OF NEUTRINO RADIATION. Kocharov, G. E.; Starbunov, Yu. N. (Ioffe Inst. of Physics and

Tech., Leningrad). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 353-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The results of the experiments carried out by Davis are discussed. The assumption that the solar material contains some initial ^{3}He is considered. It is shown that the negative results of the neutrino experiments may be explained without a drastic change of the main assumptions concerning stellar evolution. It is pointed out that there is a possibility to find out experimentally whether a star consists of matter or antimatter. For this purpose the neutrino and antineutrino radiation should be registered simultaneously during the collapse of the star. (auth)

36730 METHOD OF GLOBAL SURVEY FOR INVESTIGATING COSMIC-RAY MODULATION. Altukhov, A. M.; Krymskii, G. F.; Kuzmin, A. I. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 457-60(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A method is suggested to evaluate the experimental data on cosmic-ray variations observed at a number of stations. As a result, values of the density and the three-dimensional cosmic-ray current for each interval of observation are obtained. The calculation is based on the "receiving vector of the cosmic-ray apparatus" and consists of linear algebraic operations. It takes into account instrumental instability and other possible errors of the data used. (auth)

36731 COSMIC RAY DENSITY GRADIENT PERPENDICULAR TO THE ECLIPTIC PLANE. Hashim, A.; Bercovitch, M. (National Research Council of Canada, Ottawa). Planet. Space Sci.; 20: No. 5, 791-801(May 1972).

The $B \times \nabla_n$ streaming due to a cosmic-ray density gradient ($\overline{\nabla}_n$) perpendicular to the ecliptic plane introduces a component into the diurnal variation that depends on the sense and direction of the interplanetary magnetic field. A detailed study was made of this effect in the diurnal variation data for 1967 and 1968 from a variety of cosmic-ray monitors. The results are consistent with a North–South gradient anisotropy expressed by a power law in rigidity, $\delta I/I = 2.8 \times 10^{-4}\ R^{0.4}$, to an upper limiting rigidity of ≈100 GV. These results imply an effective North–South gradient of ≈1.3%/A.U. for a high-latitude neutron monitor. A cursory analysis of the effect in 1965–1966 indicated an even smaller North–South gradient for these years. These results are compared with estimates of the gradient from annual wave measurements. (auth)

36732 TRANSIENT NORTH–SOUTH ANISOTROPIES IN THE COSMIC RAY INTENSITY. Mercer, J. B.; Barker, D. N. H.; Griffiths, W. K.; Hatton, C. J. (Univ. of Leeds, Eng.). Planet. Space Sci.; 20: No. 5, 721-9(May 1972).

Using data from four polar neutron monitors a search was made for North–South anisotropies in the cosmic radiation during the period August 1966–November 1967 (solar rotations 1820–1837). It was found that (a) N–S anisotropies were a common feature of the cosmic radiation, occurring on >43% of all days, (b) all Forbush decreases were accompanied by such anisotropies in the onset phase, (c) a significant proportion of days outside Forbush decreases (~35% of the days analyzed) exhibited N–S anisotropies. The existence of anisotropies with large N–S components is discussed in relation to the study of anisotropies in the ecliptic plane. (auth)

36733 ^{244}Pu FISSION TRACKS: EVIDENCE IN A LUNAR ROCK 3.95 BILLION YEARS OLD. Hutcheon, I. D.; Price, P. B. (Univ. of California, Berkeley). Science; 176: No. 4037, 909-11 (26 May 1972).

Tracks attributed to the spontaneous fission of ^{244}Pu and ^{238}U were detected in a large whitlockite crystal in the lunar breccia 14321 from the Fra Mauro formation. For a track-retention age of 3.95×10^9 years the number of plutonium tracks relative to the number of uranium tracks is 0.51 ± 0.15, provided that the rock was not heavily neutron-irradiated 3.95×10^9 years ago. (auth)

36734 HEAVY RARE GASES IN SELECTED METEORITES AND TERRESTRIAL MATERIALS. Phinney, Douglas Leroy. Minneapolis; Univ. of Minnesota (1971). 121p. University Microfilms Order No. 72-14,353.

Thesis.

Kr and Xe abundance and isotopic data are reported for stepwise heating experiments on three meteorites (Mokoia, Novo Urei, and Allende) and for melt extractions on samples of five terrestrial sedimentary rocks. The intermediate–high-temperature Xe data support the carbonaceous chondrite fission hypothesis. An anomalous ^{124}Xe, ^{126}Xe, and ^{128}Xe component, most prominent at intermediate temperatures in Mokoia and Allende, is observed and tentatively ascribed to spallation from a very high-energy proton irradiation. The trapped Xe component released at intermediate–high-temperature fractions of Novo Urei and Mokoia appears to be related to atmospheric Xe by a mass fractionation process, in agreement with previous research. Despite the absence of clearly defined linear correlations in the meteoritic Kr data, it is concluded that at least three trapped components are necessary to account for the observed isotopic variations. A correlation between $\delta_{86}^{(82)}$ and $\delta_{136}^{(130)}$ indicates that $(^{86}\text{Kr}/^{136}\text{Xe}) \simeq 0.09$ for carbonaceous chondrite fission. Abundance correlations for ^{36}Ar vs ^{84}Kr and ^{84}Kr vs ^{132}Xe are demonstrated using terrestrial material data from this work and from research reported by other investigators. These correlations are interpreted as a solubility effect. Kr and Xe isotopic patterns in terrestrial sediments studied are slightly different from atmospheric patterns. (Diss. Abstr. Int., B)

36735 ENERGY SPECTRUM OF NEUTRONS IN THE SEA-LEVEL COSMIC RADIATION. Ashton, F.; Smith, N. I.; King, J.; Mamidzhanyan, E. A. (Durham Univ., Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 25-6(1970).

From 11th international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

From observations of bursts produced by neutral particles in a thick steel absorber an estimate was obtained of the high-energy sea-level neutron spectrum. The differential energy spectrum can be represented by $N(E) = KE^{-\gamma}$ where $\gamma = 2.95 \pm 0.10$ in the energy range 50 to 1000 GeV. The measured angular distribution of neutrons about the zenith shows that nucleons of average energy 230 GeV have an attenuation length of 127 ± 15 g cm^{-2} in the atmosphere. (auth)

36736 HIGH-ENERGY NUCLEAR INTERACTIONS OBSERVED AT 5200 m ABOVE SEA LEVEL. Kamata, K. (Univ. Mayor de San Andres, La Paz, Bolivia); Maeda, T.; MacKeown, P. K.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 49-56(1970).

From 11th international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

High-energy nuclear bursts ($E > 3 \times 10^{12}$ eV) without accompanying air showers are observed at Mt. Chacaltaya (5200 m), Bolivia. These are supposed to be produced in the shielding material of the BASJE 60 m^2 shielded detector by surviving primary protons. The size spectrum of these single bursts is represented by a power function with exponent –2.4. The energy spectrum of surviving protons in the energy region 3×10^{12} to 10^{14} eV is estimated from the burst spectrum, and is found to be much steeper than the total energy spectrum of primary cosmic rays. (auth)

36737 MEASUREMENTS OF THE ABSORPTION OF THE COMPONENT GENERATING γ QUANTA IN THE TeV ENERGY RANGE. Baradzei, L. T.; Kanevskaya, E. A.; Smorodin, Yu. A.; Solov'ev, M. V. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 81-4 (1970).

From 11th international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The measurements of the fluxes of γ quanta and electrons were carried out at the two levels of the atmosphere, 197 and 700 g/cm^2, by using similar emulsion chambers. The angular and energy distributions were obtained. The absorption path of the component generating γ quanta was 108 ± 4 g/cm^2 for $E_\gamma > 1$ TeV and 94 ± 6 g/cm^2 for $E_\gamma > 5$ TeV. (auth)

36738 ENERGY SPECTRUM OF NUCLEAR-ACTIVE PARTICLES AT MOUNTAIN ALTITUDE. Nam, R. A.; Nikolskii, S. I.; Sokolovskii, V. I.; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 263-6(1970).

From 11th international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The energy spectrum of hadrons was investigated by an ionization calorimeter with lead absorber. The energy spectrum had an exponent of $\gamma = 1.58 \pm 0.09$ in the energy interval 5×10^{11} to 5×10^{12} eV and $\gamma = 2.16 \pm 0.16$ in the energy interval 6×10^{12} to 6×10^{13} eV. The result obtained was in good agreement with magnetic spectrometer data at an energy of 10^{10} eV, calorimeter data at energy of 5×10^{11} to 10^{12} eV, and photoemulsion data at $>3 \times 10^{13}$ eV. (auth)

36739 HADRON SPECTRA IN THE ATMOSPHERE. Ellsworth, R.; Yodh, G. B. (Univ. of Maryland, College Park). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 321-6(1970).

From 11th international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The present knowledge of hadron spectra ($E > 100$ GeV) in cosmic radiation at 1030, 710, and 500 g/cm^2 overburden of air is summarized. The individual measurements at a particular altitude differ from each other by factors of 10. Data clearly indicate the necessity of measuring these spectra using calorimeters with ±15% resolution in energy and of utilizing the same apparatus at different altitudes so as to be able to deduce the interaction mean free paths of hadrons in air with a minimum of ambiguity as to what is being measured. (auth)

36740 MASS SPECTRUM OF STOPPING HEAVY COSMIC-RAY PARTICLES AT SEA LEVEL. Ashton, F.; Edwards, H. J.; Kelly, G. N. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 327-31(1970).

From 11th international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Using a telescope comprising six scintillation counters of 1 m^2 area, two threshold-velocity water Cherenkov selectors, and trays of neon flash tubes, particles of mass >0.25 GeV/c^2 that stop in the telescope were selected. Rest masses of stopping particles were determined by an ionization, relative-residual-range technique and a mass spectrum was obtained. The results showed a significant flux of heavy particles. An attempt was made to interpret this flux in terms of deuteron production by high-energy protons and neutrons in the atmosphere. (auth)

36741 ISOTOPIC RATIOS OF Gd, Sm, AND Eu IN ABEE ENSTATITE CHONDRITE. Loveless, A. J. (Univ. of British Columbia, Vancouver); Yanagita, S.; Mabuchi, H.; Ozima, M.; Russell, R. D. Geochim. Cosmochim. Acta; 36: No. 6, 685-98(Jun 1972).

Because the oxidation state of enstatite chondrites is significantly lower than that of other chondrites and of the Earth, it has been postulated that this class of meteorite originated closer to the Sun, and the greater flux of secondary thermal neutrons resulting from proximity to the Sun might be observed as isotopic anomalies in these elements, some isotopes of which have very large thermal neutron cross sections. The meteorite Abee was compared with two terrestrial samples, from North and from South America. The isotope ratios ^{155}Gd/^{156}Gd, ^{157}Gd/^{158}Gd, ^{149}Sm/^{150}Sm, and ^{151}Eu/^{153}Eu were identical for the three samples studied, within experimental uncertainties of 0.15, 0.1, 0.3, and 0.3%, respectively. The uncertainties include possible sources of systematic error as well as statistical errors. On the basis of these results it is concluded that the differential thermal neutron irradiation between Abee and the Earth does not exceed 3×10^{15} neutrons/cm^2, for a uniform irradiation model, or that the dilution factor differed by less than 1.2% for the FGH model (Geophys. J., 6: 148(1962)). (auth)

36742 CALCULATIONS ON RADIO PULSES FROM EXTENSIVE AIR SHOWERS. Clay, R. W. (Univ. of Calgary, Alberta). J. Atmos. Terrest. Phys.; 34: No. 6, 1120-35(Jun 1972).

Computer calculations were made on radio emission from extensive air showers, and the lateral distribution and frequency spectra of the radiation were derived. The emission mechanism is discussed, together with a technique for studying the chemical composition of the primary particle. (auth)

Stars

Refer also to abstract 37068.

36743 UNCERTAINTIES IN THE OBSERVABLE PROPERTIES OF LOWER MAIN SEQUENCE STELLAR MODELS. Moss, D. L. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 291-6(1972).

The uncertainties in the properties of lower-main-sequence stars arising from different methods of treating the nonadiabatic parts of the convection zones are investigated numerically. (auth)

36744 OBSERVATIONS OF RAPID BLUE VARIABLES. IV. WZ SGE. Warner, Brian; Nather, R. Edward (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 297-303 (1972).

The 82-min eclipsing binary WZ Sge was observed to obtain light curves with 3-s time resolution. Rapid flickering was detected with a maximum amplitude of 10% of the total light. The variation in amplitude around the binary cycle is similar to that in other cataclysmic variables. Total eclipses of the bright spot were found, which are also of 10% amplitude. It is inferred that the bright spot is extremely active: its contribution to the total light of the system appears to be 100% modulated. These and other deductions from the light curve strongly support the model of WZ Sge recently suggested by Krzeminski and Smak (1971). (auth)

36745 OBSERVATIONS OF RAPID BLUE VARIABLES. V. VV PUPPIS. Warner, Brian; Nather, R. Edward (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 305-13(1972).

Photoelectric photometry of the 100-min binary VV Pup is reported with a time resolution of 3 s. The identification of eclipses and of other recurrent features of the light curves leads to a qualitative model for the system. In order to produce compatibility between the light curves and previously published spectra of VV Pup, it is necessary to re-interpret the spectra. The model for VV Pup is then similar to that already proposed for WZ Sge. (auth)

36746 THREE-COLOUR PHOTOMETRY OF DY PEGASI. Warner, Brian; Nather, R. Edward (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 315-19(1972).

Sequential three-colour observations of the 105-min dwarf Cepheid DY Peg are described. These show that the colours vary smoothly with phase. The shape of the loop in the two-colour diagram is well-defined. There is no evidence for any change of period in DY Peg. (auth)

36747 THREE-COLOUR PHOTOMETRY OF CY AQUARII. Nather, R. Edward; Warner, Brian (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 321-3(1972).

Sequential three-colour observations of the 88-minute dwarf Cepheid CY Aqr are reported. These show smooth variations of colour with phase. (auth)

36748 NOTE ON CIRCULATION CURRENTS IN DIFFERENTIALLY ROTATING STELLAR ENVELOPES. Brand, D. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 325-35(1972).

A simple perturbation method for calculating the circulation velocities in radiative stellar envelopes for any cylindrical rotation law is presented and applied to four such laws. (auth)

36749 COMPOSITION OF THE SUBDWARF GROOMBRIDGE 1830. Tomkin, J. Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 349-59(1972).

A curve-of-growth analysis of the halo subdwarf Gmb 1830 relative to the Sun shows that the metals are in general about 10 times less abundant than in the Sun. Calcium and titanium are relatively overabundant and manganese is underabundant. Carbon may be slightly underabundant relative to the metals, and nitrogen certainly is by a factor of at least five. (auth)

36750 COMPOSITION CHANGES DURING STELLAR EVOLUTION. Eggleton, Peter P. (California Inst. of Tech., Pasadena). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 361-76(1972).

An algorithm is presented by means of which composition changes in stars due to nuclear reactions, convection, and semiconvection can be relatively simply calculated. The algorithm is based on a simple physical picture of convective mixing as a diffusion of convective cells throughout a region of a star; however it is not essential to the method that this physical picture be exact. An attempt is made to show that the method tends, in a limiting sense, to give results which are identical with the "standard" treatment of mixing by convection or semiconvection, for a wide range of possible physical models of convective mixing. The essence of the method is the simultaneous solution, in an implicit difference scheme, of equations governing both the structure and the composition changes in a star. One defect of the method as it was employed here is discussed, and some solutions suggested. Qualitative results are presented for a 14 M$_\odot$ main-sequence star and a 0.775 M$_\odot$ horizontal-branch star. (auth)

36751 OPTICAL POLARISATION OF X PER. Baud, B.; Tinbergen, J. (Leiden Observatory, Netherlands). Nature (London); 237: No. 5349, 29-30(5 May 1972).

X Per was observed in circular polarization on Feb. 4 and 5, 1972, using a wide-band polarization modulator of Dollfus type on a 30-cm Cassegrain reflector. Assuming the degree of circular polarization to be constant, it was deduced that the degree of circular polarization was less than about 0.02%. (UK)

36752 STRUCTURE OF THE OH/INFRARED OBJECT NML CYGNUS. Davies, R. D.; Masheder, M. R. W.; Booth, R. S. (Univ. of Manchester, Jodrell Bank, Eng.). Nature (London) Phys. Sci.; 237: No. 71, 21-4(8 May 1972).

Observations of the OH emitting region around NML Cygnus are described. The data suggest a model involving a central absorbing cloud, $\sim 6 \times 10^{15}$ cm in diameter, with the OH emission coming from the outer regions. (auth)

36753 HD 197481: A PERIODIC dMe VARIABLE STAR. Torres, C. A. O.; Ferraz Mello, S.; Quast, G. R. (Instituto Tecnologico de Aeronautica, Sao Jose dos Campos, Brazil). Astrophys. Lett.; 11: No. 1, 13-14(May 1972).

The quiescent light variations of the flare star HD 197481 were studied, and the existence of enhanced ultraviolet activity at the light minimum is shown. The observations were analyzed and their connection with the dark spot model is considered. (auth)

36754 INFRARED OBSERVATIONS OF SOME SOUTHERN IR-OH SOURCES. Hyland, A. R. (Australian National Univ., Canberra); Hirst, R. A.; Robinson, G.; Thomas, J. A. Astrophys. Lett.; 11: No. 1, 7-11(May 1972).

Infrared photometry from 2.2 to 20 μm is presented for the southern ir–OH sources V Mic, R Hor, and VX Sgr. On the basis of these results and previously published infrared photometry it is shown that the infrared colors of ir–OH sources correlate well with the velocity separation of the two OH emission peaks. It is further suggested that, in the case of Mira variables, there is an upper limit to the ratio of the OH flux to the integrated optical–infrared flux, independent of far infrared color. (auth)

36755 LUMINOSITY–RADIATION RELATIONS FOR ECLIPSING BINARIES. Popovici, Calin; Dumitrescu, Alexandru (Astronomical Observatory, Bucharest). Stud. Cercet. Astron.; 16: No. 2, 123-9(1971). (In Rumanian).

Eclipsing binaries were used to find the absolute magnitude–radiation relation in the case of main-sequence stars of detached and semi-detached pairs and of subgiant stars of semi-detached pairs. A notable difference was found in these two cases which can be interpreted as an evolution effect. This relation was calculated theoretically in the case of evolution with a mass transfer and compared with observational data. (tr-auth)

36756 RADIATION FROM ACCELERATED POINT DIPOLES IN CIRCULAR AND KEPLERIAN ORBITS. Monaghan, J. J.; Shapcott, C. M. (Monash Univ., Clayton, Australia). Aust. J. Phys.; 25: No. 2, 197-206(Apr 1972).

The frequency spectrum of electromagnetic radiation from accelerated magnetic dipoles was computed for circular and Keplerian motion. For circular motion three orientations of the dipole were considered: (1) parallel to the velocity vector, (2) parallel to the radius vector, and (3) perpendicular to the plane of the circle. For Keplerian motion the orientation was taken as perpendicular to the orbit. Expressions that are valid for velocities arbitrarily small and arbitrarily close to the velocity of light were derived. The mean power radiated was determined numerically. (auth)

36757 STUDY OF THE SHORT-PERIOD CEPHEID SW PISCIUM. Ureche, Vasile (Univ., Cluj). Stud. Cercet. Astron.; 16: No. 2, 141-9(1971). (In Rumanian).

270 photographic observations of the short-period Cepheid SW Piscium, made at the Cluj Astronomic Observatory between September 4, 1964 and October 11, 1966 are presented. The map of the region and the photographic magnitudes of the comparison stars are given. The blackenings of the images on the photographic plates were measured with a MF-2 photoelectric microphotometer. From these observations the moments of 15 maxima were obtained from which the periodic elements were deduced. These elements showed the presence of the Blajko effect. By interpreting this effect as the result of the superposition of two pulsations, the value $P_b = 34.5$ days was found for the secondary period. The observations were grouped in 32 normal points with the aid of which the mean light curve was constructed. This curve shows that the variable SW Piscium is a short-period Cepheid of the RR Lyrae type, sub-type RR_{ab}. (tr-auth)

36758 EMISSION SPECTRUM OF THE ION C IV IN PLANETARY NEBULAE. Leibowitz, Elia Menachem. Cambridge, Mass.; Harvard Univ. (1971). 119p. University Microfilms Order No. 72-15,060.

Thesis.

A theory is being developed for the calculation of the energy level population of an ion in planetary nebulae in which radiative excitation is taken specifically into account. The equations of the statistical equilibrium in the population of the energy levels of the ion which are coupled with transfer equations are solved for the radiation field in the resonance lines of the ion. The spectrum of the ion C IV is computed under different excitation conditions. It is found that the difference between a pure recombination spectrum of this ion and a spectrum of a radiatively excited C IV is measurable. Radiative excitation of C IV should also be manifested in a measurable polarization of at least one emission line of the ion. No observational evidence can be found for radiative excitation of C IV in the planetary nebulae NGC 7009 and IC 2165. On the other hand, intensity ratios of C IV lines observed in the nebula NGC 1535 and perhaps also those observed in NGC 7027, 3242, 7662, IC 5117, and Anon 21h31m may be interpreted as the results of radiative excitation of C IV in these nebulae. The intensities of the C IV lines computed with a radiative excitation theory, with the assumption of a blackbody spectrum for the central stars of the planetary nebulae, and with a carbon to helium ratio in the nebulae similar to the value of this ratio in stellar atmospheres, are of the same order of magnitude as the intensities observed in several nebulae. In some cases, however, such as in NGC 7027 and 1535, the observed intensities of the C IV lines are still larger than the theoretical intensities by a factor two or three. (Diss. Abstr. Int., B)

36759 ROCKET ULTRAVIOLET SPECTRA OF DELTA SCORPII AND ZETA OPHIUCHI. Matilsky, Terry Allen. Princeton, N. J.; Princeton Univ. (1971). 57p. University Microfilms Order No. 72-14,158.

Thesis.

High-quality ultraviolet spectra of delta Scorpii (BOV) and zeta Ophiuchi (09.5V) were obtained from an Aerobee rocket carrying two Schmidt cameras. Two spectra were obtained for each target; for delta Scorpii, the region from 1110 to 1400 Å was recorded with approximately 0.5 Å resolution, as well as 1100 to 1500 Å at 1.5 Å resolution; for zeta Ophiuchi, the high-resolution spectrum extended from 1190 to 1500 Å and the low-resolution spectrum recorded 1100 to 1750 Å. Photospheric lines of C II, C III, C IV, Si III, Si IV, and S III were positively identified along with interstellar lines of H I, O I, C II, and Si II and possibly C I, N I, Al II, and S II. Theoretical line profiles were calculated from recently derived electron Stark broadening damping constants and line-blanketed LTE model atmospheres, and were compared with observed equivalent widths and line profiles. Agreement between theory and observation was generally good, showing that except in the cores of the lines (which are formed very high up in the atmosphere), LTE models adequately represent line profiles for these stars. One exception was the Si IV doublet at 1393 and 1402 Å. Unless there was an error in the damping constant for this transition (unlikely because the equivalent widths agree relatively well), non-LTE theory in the line may be necessary to calculate these two profiles. (Diss. Abstr. Int., B)

36760 FORMATION OF PLANETARY NEBULAE. Alexander, David Robert. Bloomington, Ind.; Indiana Univ. (1972). 105p. University Microfilms Order No. 72-15,907.

Thesis.

The purpose of this investigation was to study the possible mechanisms responsible for the formation of planetary nebulae. The arguments that planetary nebulae are formed by noncatastrophic events in low-mass red supergiants are reviewed. If red supergiants are considered as the precursors of planetary nebulae, three mechanisms for their formation must be considered: radiation pressure mass loss, mass loss due to dynamically unstable envelopes, and mass loss due to thermal flashes of the thin, helium-burning shell. (TSS) (Diss. Abstr. Int., B)

36761 PHOTOMETRIC STUDY OF STARS WITH COMPOSITE SPECTRA. Young, Warren Melvin. Columbus, Ohio; Ohio State Univ. (1971). 121p. University Microfilms Order No. 72-15,331.

Thesis.

The spectra of stars with composite spectra are classified using wide-band and intermediate-band photometry. The wide-band system is Johnson's UBVR system and the intermediate-band is Strömgren's uvby. The stars in the composite system were classified by comparing their color indices with those of a series of hypothetical composites which were constructed using the color indices of standard stars. Spectral classification can be achieved from the photometric data if the two stars have similar luminosities and differing spectral types. The maximum absolute magnitude difference that will permit classification of the secondary depends on the difference in spectral type. For widely differing spectral types it is about 4 magnitudes. The difference in the spectral type between the two stars must be one full letter type for the photometric spectral classification to be successful. The combined use of the two systems produces spectral classifications that are more accurate than those based only on one of them. (TSS) (Diss. Abstr. Int., B)

36762 NEAR-INFRARED PHOTOELECTRIC PHOTOMETRY OF M-TYPE SUPERGIANTS. White, Nathaniel Miller. Columbus, Ohio; Ohio State Univ. (1971). 117p. University Microfilms Order No. 72-15,323.

Thesis.

M-type supergiants were observed using a new 8-color, narrow-band, near-infrared photoelectric system. Reddening-free TiO and CN indices were measured along with a color index and magnitude at 1.04 μ. The TiO and CN indices are shown to be sufficient to duplicate the MK two-dimensional system. The accuracy in spectral types was nearly five times better than the MK system. Luminosity class I was easily separated from classes II, III, and V for normal M stars. The intrinsic color index was found and a mean relation between it and the TiO index was determined. This relation was then used to successfully determine the interstellar reddening for individual program stars. The 8-color system is shown to be a valuable tool for the study of individual M supergiants for determining interstellar absorption and the distances of supergiants. (Diss. Abstr. Int., B)

36763 HIGH-ENERGY NUCLEAR PHENOMENA IN UNIVERSE. CONCERNING ORIGIN OF LIGHT ELEMENTS IN A-TYPE PECULIAR STARS. Ito, Kensai (Rikkyo Univ., Tokyo). Tenmon Geppo; 64: No. 3, 73-8; 83(Feb 1971). (In Japanese).

Nonthermal, high-energy nuclear reactions were proposed by Hayakawa in 1954 to account for the existence of light elements in the Universe or in early-type peculiar stars. Quantitative agreement is still needed. Spallation reactions, which take place when one of a double star explodes and emits high-energy particles, were proposed to account for the light elements in A-type peculiar stars. In this article, the high-energy nuclear reaction is reviewed to provide a physical picture of the process. The high-energy nuclear reaction cannot be interpreted as evaporation from compound nuclei, and a 2-step model was proposed by Serber. Experimental data, such as cross sections for formation of the light elements, are not sufficient for quantitative calculation. The high-energy nuclear phenomena in the Universe are described. The significance of ^{53}Mn and ^{10}Be in cosmic rays is discussed. Abundance of ^{3}He and D in A-type stars is quantitatively examined on the assumption that the spallation process due to the explosion of the other star of a pair is dominant. The result is not precise enough, owing to many uncertainties involved. (Japan)

36764 STRUCTURE AND EVOLUTION OF SUPERMASSIVE ROTATING MAGNETIC POLYTROPES. Ozernoii, L. M.; Usov, V. V. (Lebedev Inst. of Physics, Moscow). Astrophys. Space Sci.; 13: No. 1, 3-35(Sep 1971).

The structure of rotating magnetic polytropes is considered in Roche approximation. Investigation of the influence of poloidal as well as toroidal magnetic fields on the conditions of the beginning of matter outflow due to rotational instability is carried out. The influence of the turbulent convection and twisting of magnetic force lines on the time of smoothing of differential rotation is considered. The estimate of the magneto-turbulence energy generated by differential rotation is presented. Both maximum possible energy output and duration of the quasi-static evolution phase up to the appearance of hydrodynamic instability due to the effects of general relativity are calculated for supermassive magnetic polytropes of index three with uniform or differential rotation. The radius-mass relation is obtained for supermassive differentially-rotating magnetic polytropes referring on the longest part of the quasi-statistical evolution stage; some consequences are pointed out, including the period–luminosity relation. The evolution of the considered models of supermassive rotating magnetic polytropes with different character of rotation and different geometry of a magnetic field is discussed. (auth)

36765 HIGHLY EXCITED HYDROGEN LINES IN STELLAR SPECTRA. I. Barcza, S. (Konkoly Observatory, Budapest). Astrophys. Space Sci.; 13: No. 1, 36-47(Sep 1971).

Solutions of the hydrogenic Schroedinger equation are given, with two boundary conditions imposed on the wave function, for distances of the order of magnitude of one hundred times the Bohr radius from from the central nucleus. Thus the shifts and splitting of the $H\gamma$–H_{26} lines that arise from the nonvacant environment are given. The Inglis–Teller limit is revised since from the shifts it follows that it gives a correct charged-particle density only in the case of extremely high electron and ion densities. The gas density is derived from the number of the visible Balmer lines, and usually the widths and the contours, but not the coalescence, include information on the charged-particle density. (auth)

36766 RELATIVISTIC EJECTION OF A PARTICLE BY RADIATION PRESSURE. Noerdlinger, Peter D. (Univ. of California, Santa Cruz). Astrophys. Space Sci.; 13: No. 1, 70-3(Sep 1971).

The Poynting–Robertson formulae were used to evaluate the motion and terminal velocity of a particle ejected from rest in a powerful radiation field due to a point source, generalizing the results of Chandrasekhar (1934) to the relativistic case. (auth)

36767 NOVA DELPHINI 1967. OBSERVATIONS OF THE NEBULAR SPECTRA BETWEEN 5600 AND 8800 A IN 1970. Andrillat, Yvette (Laboratoire d'Astronomie, Montpellier, France); Houziaux, Leo. Astrophys. Space Sci.; 13: No. 1, 100-5(Sep 1971).

Five 230 Å/mm infrared spectra of Nova Delphini 1967 were obtained from May to September 1970 on Kodak hypersensitized IN plates. Visual brightness dropped by one magnitude between fall 1969 and fall 1970. The continuous spectrum remained strong and a mean value of 2.35 was found for the gradient in the region 6000 to 8000 Å, indicating a slight increase in temperature since 1969. Permitted lines of H I, O I, He I, Fe II were weakening, while intensities of forbidden transitions due to [N II], [Fe VII], [O I], [O II], [Ar III], [Ar V], [Fe VII], [Fe X], [Fe XI], [Ni XV] were much more stable. At the dispersion of the spectra, there was little evidence of activity in the nova shell during 1970. Temperature seemed to be slightly increasing in the lower layers as well as in the external, low-density regions. (auth)

36768 TURBULENT VELOCITY WAVES AND KINEMATIC DYNAMO ACTIVITY. Lerche, I. (Univ. of Chicago). Astrophys. Space Sci.; 13: No. 1, 137-47(Sep 1971).

It is demonstrated that a turbulent distribution of small-amplitude velocity waves gives rise to kinematic dynamo activity on its own in an infinite medium. As the wave speed increases, the intensity of the waves has to increase in order to support dynamo regeneration. The theory given is statistically exact, but in view of the complexity of the resulting equations, the answers presented are for the long-wavelength (i.e., large-scale) magnetic field. In view of the fact that most astrophysical objects apparently contain turbulent wave motions, the present calculation is indicative of the extent to which turbulent dynamo activity may be physically important in such objects. (auth)

36769 ROLE OF THE COLLISIONALLY BROADENED WINGS OF STRONG LINES IN THE BLANKETING PROBLEM. Natta, A.; Preite-Martinez, A. (Laboratorio de Astrofisica Spaziale, Frascati, Italy). Astrophys. Space Sci.; 13: No. 1, 148-53(Sep 1971).

The importance in the blanketing effect of the wings of strong lines broadened by collisions was evaluated. It was found that, in stars of spectral types F5–K5, the cumulative absorption by a group of lines was due half to the center of the lines and half to the wings. For the same stars the influence of the collisional broadening on the computed color indices (U–B), (B–V) was evaluated. (auth)

36770 NUCLEAR AND NONNUCLEAR PROCESSES IN THE PRODUCTION OF PECULIAR A STARS. Gutherie, B. N. G. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 13: No. 1, 168-79(Sep 1971).

Recent theories of the origin of the abundance anomalies in Ap stars are reviewed. The abundance anomalies are mainly the results of supernova explosions of companion stars and magnetic accretion from the supernova remnants and the interstellar medium. Large rare-earth excesses indicate that magnetic accretion has taken place, while large excesses of Pt and Hg are due to the transfer of material from nearby supernovae. Nuclear reactions involving protons may also have taken place around Ap stars. There are several objections to Michaud's diffusion theory as a comprehensive explanation for Ap abundance anomalies. (auth)

36771 STELLAR PHOTOMETRY IN THE REGION 1300 TO 2000 A. PART II. Campbell, J. W. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 13: No. 1, 189-202(Sep 1971).

Observations were made at 1450 Å of 94 early type stars. Comparison was made with other observations, and in general, good agreement was found. Errors in absolute calibration of earlier observations led to some disagreement. The data agreed well with theoretical stellar models which include the effects of line blanketing. (auth)

36772 VARIATION OF SPECIFIC ANGULAR MOMENTUM AMONG MAIN SEQUENCE STARS. Tarafdar, S. P.; Vardya, M. S. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 13: No. 1, 234-48(Sep 1971).

The specific angular momentum is found to vary with mass for earlier and later-type main-sequence stars. Of various plausible causes, the difference in the interior density distribution of earlier and later-type stars is not sufficient enough to explain the difference either in angular momentum or in its gradient between earlier and later-type stars. The nonrigid rotation, however, may account for this difference in specific angular momentum as well as its gradient, if faster angular velocity in the interior for later-type and/or slower angular velocity for earlier-type stars than the surface value is allowed. A few other possibilities are also briefly considered to understand this difference. (auth)

36773 NEW APPROXIMATE FORMS FOR THE H-FUNCTION FOR ISOTROPIC SCATTERING. Karanjai, S. (Univ. of

North Bengal, West Bengal, India). Astrophys. Space Sci.; 13: No. 1, 267-72(Sep 1971).

Three new approximate forms for the H-function for isotropic scattering were developed. Each of the forms involved three unknown functions of albedo. (auth)

36774 ULTRAVIOLET EMISSION FROM THE STARS. Bates, B.; McKeith, C. D. (Queen's Univ., Belfast). Contemp. Phys.; 13: No. 3, 225-46(May 1972).

The detailed spectral energy distribution of the radiation emitted by stars provides information on their composition and physical parameters. Many of the astrophysically important spectral lines of neutral and ionized atoms whose study can lead to a better understanding of the processes occurring in stellar atmospheres and in the interstellar gas lie in the ultraviolet region of the spectrum. Since ultraviolet radiation from the stars is absorbed by the Earth's atmosphere, observations must be made from space vehicles. Some scientific objectives of a program in ultraviolet astronomy are considered, and a review made of the types of space vehicles and attitude control systems employed. A brief discussion is included of some recent results and their interpretation. (auth)

36775 IS X PERSEI AN X-RAY SOURCE? Crampton, D.; Hutchings, J. B. (Dominion Astrophysical Observatory, Victoria, British Columbia). Nature (London); 237: No. 5350, 92-3(12 May 1972).

It has been suggested that the star X Per (HD 24534) may be associated with the x-ray source 2U 0352 + 30. Other stars identified with x-ray sources are characterized by peculiar spectra with unusual emission lines and by variations in radial velocity, suggesting that the sources are binary systems. A series of spectra of X Per was obtained between Dec. 27, 1971 and March 30, 1972, and details of these spectra are described and discussed. It is concluded that, although X Per is similar in several ways to other x-ray source candidates, it is not markedly different from a normal Be star, and its final identification as 2U 0352 + 30 must be left open. Photoelectric photometry and spectrophotometry of the star may yield more definite information. (UK)

36776 STABILITY OF A MODEL OF A GLOBULAR STAR CLUSTER WITH NON-ZERO ANGULAR MOMENTUM. Synakh, V. S.; Fridman, A. M.; Shukhman, I. G. (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR; 201: No. 4, 827-30 (1 Dec 1971). (In Russian).

Previous investigators have considered the stability of a model of a globular star cluster revolving about a nearly circular trajectory, with zero total angular momentum. Here, the possibility of gravitational instability of such a system, which would result in decelerating its revolution, is explored. (K.S.W.)

36777 LIFETIMES OF GALACTIC CLUSTERS. Wielen, R. (Astronomisches Rechen-Institut, Heidelberg). Astrophys. Space Sci.; 13: No. 2, 300-8(Oct 1971).

From the observed age distribution of galactic clusters within 1 kpc it is deduced that the typical total lifetime of a galactic cluster is about 2×10^8 yr. The individual lifetimes vary between 10^8 and 10^{10} yr. The observed lifetimes are compared with the evaporation times found from numerical experiments with star cluster models. These models contain up to 250 stars with a realistic mass spectrum. The effect of the galactic tidal field is taken into account and enhances the rate of escape significantly. Escapers are identified by using the Jacobian integral. The evaporation time is given in years as a function of the median radius for different values of the total mass of a cluster. The agreement between the resulting theoretical lifetimes and the observed values is sufficiently good. It is estimated that the tidal field of passing interstellar clouds should be in most cases less efficient in dissolving a galactic cluster than the internal evaporation process combined with the effect of the general galactic field. (auth)

36778 MONTE CARLO MODELS OF STAR CLUSTERS. Henon, M. (Observatoire, Nice). Astrophys. Space Sci.; 13: No. 2, 284-99(Oct 1971).

The dynamical evolution of spherical star clusters under the effect of internal encounters is followed numerically using a Monte Carlo procedure. Successive states of the system are computed, separated by a time step which is a fraction of the relaxation time. In any given state, each star is characterized by its total energy and its angular momentum with respect to the center. Changes in these two quantities from one state to the next are computed by randomly selecting the position of the star on its orbit, randomly choosing a field star, letting the two stars interact, and multiplying the effect by an appropriate factor. This procedure can be shown to reproduce correctly the behavior of the system as given by the Fokker–Planck equation. The computation is much faster than the exact N-body integration. Multiple-encounter effects are neglected, but this is probably not of serious consequence when N is large. Some provisional results are presented. Once more it is found that N-body systems develop a very high central density peak. The velocity distribution becomes isotropic in the central parts, radially elongated in the halo. Models started with widely different initial conditions tend to become similar after a few relaxation times. The presence of a tidal field, or a distribution of masses, accelerates the evolution of the system. (auth)

36779 NUMERICAL EXPERIMENTS ON THE ESCAPE FROM NONISOLATED CLUSTERS AND THE FORMATION OF MULTIPLE STARS. Hayli, Avram (College de France, Paris). Astrophys. Space Sci.; 13: No. 2, 309-23(Oct 1971).

Isolated and nonisolated clusters with a mass distribution were studied by numerical techniques. The rates of escape of stars and of kinetic energy were compared with Hénon's theoretical expressions. Multiple encounters play a very important role in the escape phenomenon, at least for clusters with a small number of stars. This leads to a theoretical underestimate of the rates of escape when the stars have equal masses and to an overestimate when masses are unequal. For nonisolated clusters, the tidal field of the Galaxy is responsible for one half of the rate of escape of the stars. The energy of a star escaping because of the tidal effect grows slowly while that of a star escaping after an encounter increases very rapidly. The stars escaping because of the tidal effect leave the cluster in the vicinity of the equilibrium points. Encounters and the tidal field are not efficient enough to explain why very old open clusters are not observed. Other escape mechanisms have to be considered. Very stable subsystems are formed which are not destroyed under the influence of the galactic tide. Separation between stars can be as low as 1000 AU. (auth)

36780 BINARY EVOLUTION IN STELLAR SYSTEMS. Aarseth, S. J. (Inst. of Theoretical Astronomy, Cambridge, Eng.). Astrophys. Space Sci.; 13: No. 2, 324-34(Oct 1971).

Three new star cluster models containing 250 members and one case with 500 particles were studied by numerical methods of direct integration. The evolution is dominated by one central binary in all systems with a realistic mass spectrum and more than 50% of the total energy is absorbed by one heavy pair after only 6 to 18 mean crossing times. General conditions for binary formation and disruption are discussed, and a qualitative explanation is given for the energy sink behavior. Strong interactions with close binaries lead to increased relaxation and the ejection of energetic escapers. At the same time the corresponding recoil kinetic energy is transferred to the other central members by two-body encounters, which prevent a secondary phase of central contraction. (auth)

36781 DISSOLUTION TIME OF A CLASS OF BINARY SYSTEMS. Cruz-Gonzalez, Carlos (Univ. Nacional Autonoma de Mexico, Mexico City); Poveda, Arcadio. Astrophys. Space Sci.; 13: No. 2, 335-49(Oct 1971).

To test the various theories of the dissolution time of binary systems, a series of numerical experiments was performed. The present simulations represent a number of binaries subject to perturbations by passing field stars. Various masses and velocities of the field stars were used to exhibit their effects on the dissolution time. Because of simplicity, the pairs considered consisted of a primary of one solar mass plus a secondary of negligible mass. The computations gave, among other things, the evolution in time of the energies and eccentricities of the secondary components. From these results the need was found to redefine the concept of time of dissolution to represent more realistically the rate of loss of secondary components. The dissolution times found from the computations did not agree with any of the existing theories, neither in the general behavior nor in actual numerical values. The times of dissolution found in the calculations were between a factor of two and a factor of fifteen longer than predicted by existing theories. (auth)

36782 REPRODUCIBILITY OF RUN-AWAY STARS FORMED IN COLLAPSING CLUSTERS. Allen, Christine (Univ. Nacional Autonoma de Mexico, Mexico City); Poveda, Arcadio. Astrophys. Space Sci.; 13: No. 2, 350-9(Oct 1971).

To test the stability of the trajectories of run-away stars the results of a comparative study of 26 star clusters involving very strong encounters are presented. Each one of these clusters was computed with different time steps, different techniques of integration, and on different machines. It was confirmed that, in general, the values of the energies, velocities, and positions for the individual stars were not reproducible from run to run. It was found, however, that in all the cases tested, the run-away star preserved its energy, velocity, and position from one run to another. It was also found that escapers were more reproducible than stars with negative energy. (auth)

36783 NUMERICAL EXPERIMENT ON RELAXATION TIMES IN STELLAR DYNAMICS. Lecar, Myron; Cruz-Gonzalez, Carlos (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Space Sci.; 13: No. 2, 360-4(Oct 1971).

The deflection of the velocity vector of a massless test star in the field of 100 stars was determined by numerical integration. The deflection due to each field star independently (with the other field stars removed) was also determined. The square of the deflection caused by the combined action of the field stars agreed quantitatively with the sum of the squares of the individual deflections and also with the theoretical estimate of Williamson and Chandrasekhar. (auth)

36784 RECENT DEVELOPMENTS OF INTEGRATING THE GRAVITATIONAL PROBLEM OF N-BODIES. Szebehely, Victor; Bettis, Dale G. (Univ. of Texas, Austin). Astrophys. Space Sci.; 13: No. 2, 365-76(Oct 1971).

The formulation and the numerical integration of large systems of differential equations occurring in the gravitational problem of n-bodies are discussed. Different forms of the pertinent differential equations of motion are presented, and various regularizing and smoothing transformations are compared. Details regarding the effectiveness and the efficiency of the Kustaanheimo–Stiefel and of other methods are discussed. In particular, a method is described in which some of the phase variables are treated in the regularized system and others in the ordinary system. This mixed method of numerical regularization offers some advantages. Several numerical integration techniques are compared. A high-order Runge–Kutta method, Steffensen's method, and a finite difference method are investigated, especially with regard to their adaptability to regularization. The role of integrals and integral invariants is displayed in controlling the accuracy of the numerical integration. Numerical results are described with 5, 25, and 500 bodies participating. These examples compare the various integration techniques, several regularization methods and different logics in treating binaries. (auth)

36785 COLLISIONLESS STELLAR DYNAMICS. Contopoulos, G (Univ. of Thessaloniki, Greece). Astrophys. Space Sci.; 13: No. 2, 377-86(Oct 1971).

Collisionless stellar dynamics deals with stellar systems for times small with respect to the relaxation time. Thus it disregards completely individual encounters between stars. The basic equation is the collisionless Boltzmann equation. (W.D.M.)

36786 STABILITY OF AN ENCOUNTERLESS SELF-GRAVITATING CONSTANT DENSITY SYSTEM. Goldstein, S. (Tel-Aviv Univ., Israel). Astrophys. Space Sci.; 13: No. 2, 387-96 (Oct 1971).

The stability of a constant density, self-gravitating system is investigated. The system considered is one-dimensional, collisionless, and described by the sheet model. The equilibrium distribution function F(E), E being the energy, is such that the system had constant density in real space over a finite region. An analytical treatment as well as computer experiment showed stability for symmetric disturbances. (auth)

36787 NUMERICAL EXPERIMENTS ON LYNDEN-BELL'S STATISTICS. Lecar, Myron (Smithsonian Astrophysical Observatory, Cambridge, Mass. Harvard Coll. Observatory, Cambridge, Mass.); Cohen, Leon. Astrophys. Space Sci.; 13: No. 2, 397-410(Oct 1971).

Computer experiments were performed on 13 different initial configurations of one-dimensional self-gravitating systems. The three most and the three least violently relaxed systems were compared with the predictions of Lynden–Bell's statistical mechanics. The agreement between the experimental results and the theoretical predictions became worse as the relaxation became more violent. While all six systems were theoretically nondegenerate, the violent systems invariably flung out a halo that took most of the energy, leaving behind a low-energy degenerate core. (auth)

36788 PHASE-SPACE BOUNDARY INTEGRATION OF THE VLASOV EQUATION FOR COLLISIONLESS ONE-DIMENSIONAL STELLAR SYSTEMS. Cuperman, S. (Tel-Aviv Univ., Ramat-Aviv, Israel); Harten, A.; Lecar, M. Astrophys. Space Sci.; 13: No. 2, 411-24(Oct 1971).

The evolution of one dimensional (stratified) self-gravitating systems of stars with constant phase-space density ("water-bag" model) is investigated by following the motion of the boundary curves defining the systems. The results are compared with those obtained by sheet-model computer experiments and good agreement is found. New aspects of the evolution, revealed by the method, are discussed. (auth)

36789 COLLECTIVE RELAXATION OF TWO-PHASE-SPACE-DENSITY COLLISIONLESS ONE-DIMENSIONAL SELFGRAVITATING SYSTEMS. Cuperman, S. (Tel-Aviv Univ., Ramat-Aviv, Israel); Harten, A.; Lecar, M. Astrophys. Space Sci.; 13: No. 2, 425-45(Oct 1971).

The evolution of one-dimensional two-phase-space-density self-gravitating systems of stars was investigated by following the motion of the boundary curves of the systems in phase space. A qualitative agreement with Lynden–Bell's theory predicting, for the most probable state, velocity dispersions inversely proportional to the phase space density of the component at the star formation, was found. (auth)

36790 ENHANCEMENT OF RELAXATION PROCESSES BY COLLECTIVE EFFECTS. Kulsrud, Russell M. (Princeton Univ., N. J.). Astrophys. Space Sci.; 13: No. 2, 468-77(Oct 1971).

The various collective processes in plasma physics are reviewed, in a general fashion, with an emphasis on their possible relevance to stellar dynamics. (W.D.M.)

36791 STABILITY PROPERTIES FOR ENCOUNTERLESS SELF-GRAVITATIONAL STELLAR GAS AND PLASMA. Feix, M. R.; Doremus, J. P.; Baumann, G. (Univ., Nancy). Astrophys. Space Sci.; 13: No. 2, 478-95(Oct 1971).

The stability properties of the collisionless plasma and encounterless stellar gas described by the Vlasov equations are studied. The introduction of the "multiple water-bag" model allows, for one-dimensional plane geometry, a treatment of the general case and removes some of the difficulties connected with the formulation of the energy variation. From this last result it can be deduced that both plasma and stellar systems steady state described by a monotonically decreasing distribution $F(\epsilon)$ are stable. The demonstration is extended to the spherically symmetric case for self-gravitating gas. Next the constraint of a monotonically decreasing $F(\epsilon)$ is relaxed and it is supposed that the instability appears through the point $\omega = 0$. This is known to be true for some type of plasma instabilities (two streams) but is a simple working hypothesis in the gravitational case. For this marginal mode the N "bags" equations degenerate into a single wave equation and the stability of the system is given by the sign of the eigenvalues of a Schroedinger type operator. A simple physical picture is obtained for the plasma case where the quantity $\int(dF/d\epsilon)\, dV$ (the square of the local maximum wavenumber of instability) is introduced. A virtual variation of this quantity indicates if the initial steady state was stable or unstable. (auth)

36792 ACCRETION OF MATERIAL BY THETA ORIONIS C. Conti, Peter S. (Univ. of Colorado, Boulder). Astrophys. J.; 174: No. 2, L79-86(1 Jun 1972).

Observations of an inverse P Cygni profile in the He II line λ4686 are reported and interpreted as infalling material. The profile of this line, and presumably the density of the infalling material, varies over a time scale of days. (auth)

36793 LOW-LUMINOSITY STAR G51-15. Dahn, C. C.; Behall, A. L.; Guetter, H. H.; (and others) (Naval Observatory, Washington, D. C.). Astrophys. J.; 174: No. 2, L87(1 Jun 1972).

Photometric and astrometric observations of the high-proper-motion star G51–15 indicated that the star with $M_v = 16.97$ mag and $V - I = 4.34$ mag lies on the low-luminosity extension of the main sequence and is one of the faintest stars known in intrinsic brightness. (auth)

36794 HIGHLY REDDENED STAR NEAR NGC 6231. Herbig, G. H. (Univ. of California, Santa Cruz). Astrophys. J.; 174: No. 2, L89-91(1 Jun 1972).

The very red $(B - V = +3.5)$ twelfth-magnitude star discovered by Sanduleak and by Seggewiss near the edge of the young cluster NGC 6231 is a normal F5 Ia, with a radial velocity differing by 24 km s^{-1} from the cluster mean. It is probably a background super-supergiant, and not an R CrB-type member of the cluster. (auth)

36795 FAR-ULTRAVIOLET EMISSION SPECTRUM OF THE K2 III STAR, ARCTURUS. Moos, H. W.; Rottman, G. J. (Johns Hopkins Univ., Baltimore). Astrophys. J.; 174: No. 2, L73-7(1 Jun 1972).

A moderate-resolution far-ultraviolet spectrum of the K2 IIIp star Arcturus (α Boo), obtained with a rocket-borne spectrometer, showed chromospheric emission features. Hydrogen Lα and O I λ1304 were clearly identified. The O I λ1304 stellar surface brightness was as great or greater than that of the Sun. Other metal lines, including those of carbon, were weak compared to the O I line. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 36775, 36832, 36841, and 36926.

36796 (TID-3320(Suppl.2)) PULSARS. Bibliography. Matheny, William D. (Technical Information Center (AEC), Oak Ridge, Tenn.). May 1972. 97p. Dep. NTIS.

This bibliography consists of 629 abstracts taken from Nuclear Science Abstracts, Vol. 25 and Vol. 26. The time period covered is essentially 1971. The indexes were compiled by computer from the original NSA indexing. For abstracts covering the period up to 1970, see TID-3320 and TID-3320 (Suppl. 1). (W.D.M.)

36797 POLARIZATION OF RADIO SOURCES WITH APPRECIABLE REDSHIFT. Kronberg, P. P.; Conway, R. G.; Gilbert, J. A. (Univ. of Toronto). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 275-82(1972).

Observations of the linear polarization of quasi-stellar radio sources over a wide range of wavelengths were combined to investigate the depolarization at long wavelengths. It is suggested that the main cause is Faraday dispersion occurring in or near the source itself. A strong correlation is found between the rate of depolarization and the redshift for 62 quasars. (auth)

36798 SPECTRAL INDEX–LUMINOSITY RELATION FOR RADIO GALAXIES AND QUASI-STELLAR SOURCES. Bridle, A. H.; Kesteven, M. J. L.; Guindon, B. (Queen's Univ., Kingston, Ont.). Astrophys. Lett.; 11: No. 1, 27-30(May 1972).

Data on the spectra of radio galaxies and quasi-stellar sources between 100 MHz and 7 GHz were used to examine the spectral index–luminosity relation. There was a statistically significant relation when only radio galaxies with power-law spectra were considered. The quasi-stellar sources with power-law spectra may continue the relation to luminosities greater than those of the galaxies. (auth)

36799 CLASSIFICATION OF NEW OH SOFRCES. Dickinson, Dale F. (Harvard Coll. Observatory, Cambridge, Mass. Smithsonian Astrophysical Observatory, Cambridge, Mass.); Turner, B. E. Astrophys. Lett.; 11: No. 1, 1-5(May 1972).

Main-line polarization and satellite-line observations were made on 55 new hydroxyl ion sources. The emission sources can all be described by the OH source categories proposed by Turner. (auth)

36800 LUNAR OCCULTATION OBSERVATIONS OF 24 RADIO SOURCES. Clarke, R. W. (CSIRO, Epping, Australia). Aust. J. Phys.; 25: No. 2, 215-32(Apr 1972).

Some details of the structure of 24 radio sources were deduced from measurements of the occultation of radio sources by the Moon. The measurements were made at Parkes between July 1964 and December 1966. Most of the sources were resolved and shown to have structure greater than 2′′ arc in extent. A brief description is given of the observing technique and of the method of analysis. (auth)

36801 ATTEMPT TO EXPLAIN QUANTITATIVELY OBSERVED VARIATIONS IN THE FLUX DENSITIES OF SEVEN EXTRAGALACTIC RADIO SOURCES IN TERMS OF THE EXPANDING CLOUD MODEL. Waak, John Alphonse J. Washington, D. C.; Georgetown Univ. (1972). 191p. University Microfilms Order No. 72-16,043.

Thesis.

Results of the NRL program to monitor flux density variations of seven of the strongest of the previously known variable extragalactic radio sources at wavelengths of 0.95 and 1.55/1.65 cm are presented. Observations at both wavelengths were begun in mid-1966. The 0.95-cm observations were terminated after November 1969, while the 1.65-cm part of the program is continuing. An attempt is made to explain the detailed 1.55/1.65-cm variations in terms of the "expanding cloud" model of van der Laan and Shklovskii, but incorporating an acceleration parameter and a time invariant contribution. The outcome of this attempt was generally a contradiction between parameters derived from the increasing (optically thick) and decreasing (optically thin) portions of the radio "light curves." Following the failure of the above approach, an attempt was made to incorporate data provided by other investigators over a wavelength range of 0.33 to 6 cm along with the NRL data to provide a test of the applicability of this model to these sources using relationships required by the model for the wavelength dependence of the epoch of maximum and the maximum flux density. The results of this analysis indicate that for three of the sources (3C 273, 3C 345, and 3C 120) the proposed mechanism is satisfactory, for two others (3C 279 and 3C 446) the observed variations are not sufficiently pronounced to provide a reasonable quantitative test, and for two sources (3C 454.3 and 3C 84) some refinements to the model will be necessary before the data on this pair of quasars can be adequately represented. (Diss. Abstr. Int., B)

36802 COMMENTS ON THE FARADAY ROTATION AND SIGNAL DISPERSION BY I. LERCHE. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow); Erukhimov, L. M. Astrophys. Space Sci.; 13: No. 1, 53-5(Sep 1971).

In a paper by the authors (1970) it was concluded that the final statements made by Lerche in his papers (1970a, b) were incorrect. Lerche's reply (1971) is further commented upon. (W.D.M.)

36803 INDUCED COMPTON SCATTERING BY RELATIVISTIC PARTICLES. Melrose, D. B. (Australian National Univ., Canberra). Astrophys. Space Sci.; 13: No. 1, 56-69(Sep 1971).

Equations describing the evolution of isotropic distributions of unpolarized electromagnetic waves and of scattering particles of any energy due to spontaneous and induced Compton scattering are derived in the semi-classical approximation for unshielded particles. It is shown that induced Compton scattering of high-frequency waves by relativistic electrons in synchrotron sources is a negligible effect contrary to the conclusions of Oster (1968b) and of Kaplan and Tsytovich (1969). (auth)

36804 FORMATION OF PULSAR RADIATION DIAGRAMS. Zheleznyakov, V. V. (Radiophysical Inst., Gorky, USSR). Astrophys. Space Sci.; 13: No. 1, 87-99(Sep 1971).

A model of pulsars is discussed in which formation of a polar diagram of the radiation is influenced by the motion of the source around a neutron star with a velocity close to that of light. For a power-law frequency spectrum of the radiation and isotropy of the diagram in a system of coordinates rotating with the source, the width of the observed pulse is shown to be independent of frequency. The proposed explanation of the second period characteristics of type CP 1919 pulsars is based on the effect of relativistic motion of the radiation source. The positions are established (relative to the axis of rotation of the star) of the local sources of radiation in the optical and in the radio ranges for the pulsar NP 0532. It is shown how the polarization characteristics of the optical radiation of this pulsar may be connected with the effects of relativistic orbiting of the source of radiation about the star. (auth)

36805 OBSERVATIONS OF HIGH VELOCITIES IN H II REGIONS WITH A TWO-ETALON FABRY–PEROT SPECTROMETER. Meaburn, J. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 13: No. 1, 110-27(Sep 1971).

High internal motions of the ionized material in the H II regions M 8, M 16, M 17, and the Orion Nebula were searched for with a two-etalon Fabry–Perot monochromotor. The profiles of the [O III], 5007-Å and, in one case, the 4959-Å line were obtained at many positions from these nebulae. Non-gaussian wings of up to −60 km/s were found on the profiles from M 17 and M 16 over regions several minutes across. Line doubling of up to 20 km/s was definitely found in M 17 and M 8. Small components with radial velocities of up to −55 km/s with respect to the means were suspected in M 8 and the Orion Nebula. (auth)

36806 GINZBURG–LANDAU THEORY OF ANISOTROPIC SUPERFLUID NEUTRON-STAR MATTER. Richardson, R. W. (New York Univ., N. Y.). Phys. Rev., D; 5: No. 8, 1883-96(15 Apr 1972).

The Gor'kov procedure was used to obtain a generalized Ginzburg–Landau theory for anisotropic superfluid neutron-star matter. The resulting equations were solved for the case of superfluid flow past a plane boundary and the case of an isolated vortex line. The structure of these solutions and their connection with rotating neutron stars is discussed. (auth)

36807 SPECTROSCOPIC OBSERVATIONS OF 22 QUASI-STELLAR OBJECTS. Burbidge, E. Margaret (Univ. of California, San Diego); Strittmatter, P. A. Astrophys. J.; 174: No. 2, L57-62(1 Jun 1972).

Spectroscopic observations of 22 QSOs are described, and redshifts of 20 are given. A corrected redshift for 3C 407 is included, and an error in that published for PKS 0226 − 038 is pointed out. The variability of the large-redshift 5C 2.56 is discussed. Lines of Si II were found in OI 318. (auth)

36808 VARIABILITY OF THE OPTICAL INTENSITY AND PLANE POLARIZATION OF OJ 287. Williams, W. L.; Rich, A.;

Kupferman, P. N.; Ionson, J. A.; Hiltner, W. A. (Univ. of Michigan, Ann Arbor). Astrophys. J.; 174: No. 2, L63-4(1 Jun 1972).

Photometric and plane polarimetric observations of the radio source OJ 287 were made in the optical region. The photometric data showed variations of 0.10 mag with a timescale of 6 to 7 days superposed on a total decrease of approximately 0.5 mag during February 1972. The polarimetric data, which exhibited a similar decrease in plane polarization during this same period, suggested the possibility of a periodicity with a timescale of the order of 30 days. (auth)

36809 MICROWAVE SPECTRUM OF ISOCYANIC ACID, HNCO. Hocking, W. H. (Univ. of British Columbia, Vancouver); Gerry, M. C. L.; Winnewisser, Gisbert. Astrophys. J.; 174: No. 2, L93-6(1 Jun 1972).

Laboratory measurements are reported on rotational transitions of isocyanic acid, HNCO, which are of potential interest in radio astronomy. Observations of various a-type R-branch transitions for the isotopic species $H^{15}N^{12}C^{16}O$, $H^{14}N^{13}C^{16}O$, and $H^{14}N^{12}C^{18}O$ were made. It was found that the rotational transitions of the $H^{14}N^{13}C^{16}O$ species were displaced toward higher frequencies from those of $H^{14}N^{12}C^{16}O$. The $4_{04}-3_{03}$ transition at 87927.67 MHz of $H^{14}N^{13}C^{16}O$ was located 2.22 MHz higher in frequency than the corresponding $H^{14}N^{12}C^{16}O$ transition. The location of the rotational lines of the other isotopic species was in close agreement with predictions based on the presently available structural data of the molecule. (auth)

Solar Phenomena

Refer also to abstracts 36159 and 36899.

36810 (0,0) BAND OF THE γ-SYSTEM OF TiO IN THE UMBRAL SPECTRUM: THE ISOTOPIC ABUNDANCES OF Ti. Lambert, D. L.; Mallia, E. A. (Univ. of Texas, Austin). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 337-48(1972).

Photoelectric spectra of the γ-system of TiO in sunspot umbrae are examined for the presence of the less-abundant stable isotopes of Ti. From comparisons of computed spectra with observations in the wavelength region of minimum line density (7065 to 7085 A), the solar and terrestrial abundances of ^{46,47,49,50}Ti relative to ^{48}Ti are shown to be equal to within ±30%. Analysis of ^{48}TiO lines yields a value for the band oscillator strength: $f_{0,0} = 0.034$ with an adopted dissociation energy of TiO of 7.2 eV and the model umbral atmosphere proposed by Stellmacher and Wiehr. A significant dependence of the f-value on dissociation energy and model atmosphere is found. Line profiles in the α- and γ-systems require a microturbulent velocity of $\xi_t = 1.2 \pm 0.1$ km s^{-1}. (auth)

36811 LIGHT OF THE NIGHT SKY AND THE INTERPLANETARY MEDIUM. Ingham, M. F. (Oxford Univ.). Rep. Progr. Phys.; 34: No. 9, 875-912(1971).

Four of the components of the light of the night sky are described; the aurora is not included. The early history of star counting to determine the brightness of the integrated starlight is reviewed, and suggestions are made for improving upon this work and extending it to longer wavelengths. Work on the zodiacal light since 1967 is described in detail. The most recent observations of surface brightness, polarization, and the spectrum are given, and the motions and origin of the interplanetary dust particles are emphasized. A survey is made of the known emissions of the night airglow with reference to their emitting heights, their variation with time and photochemistry. Particular attention is paid to the problem of the nightglow continuum and the diffuse Lyman-α radiation from the night sky is considered in some detail. Brief mention is made of the diffuse galactic radiation as a possible contributor to the light of the night sky. (auth)

36812 SOLAR NEUTRINO PROBLEM. Bahcall, J. N. Comments Nucl. Particle Phys.; 5: No. 2, 59-64(Mar-Apr 1972).

It is stated that the basic motivation for making solar neutrino experiments, such as the Brookhaven Solar Neutrino experiment, is to test quantitatively theories of nuclear energy generation in stars and theories of stellar evolution. Neutrinos, because of their large mean free paths, can reach us directly from the deep interior of a star, where the temperature is highest and the nuclear reactions responsible for the energy generation and stellar evolution occur. The conventional wisdom regarding nuclear fusion as the energy source for main-sequence stars like the Sun is first discussed, including consideration of the principal reactions involved, with particular reference to the neutrino-producing reactions. In order to calculate how often the various nuclear reactions occur, a detailed model of the interior of the Sun is required; the techniques for constructing such models are standard, although greater precision is required for the solar neutrino problem than for most other problems in stellar evolution. Appropriate models are discussed. Data are quoted from the Brookhaven ^{37}Cl experiment, indicating that something is seriously wrong with theory. A speculative suggestion has been made, as a possible resolution of the difficulty, that the electron neutrino is unstable over solar system distances, although stable over laboratory distances; predictions arising from this suggestion are discussed. The whole matter represents a crisis, as between ordinary physics and astrophysics, and more experimental work is necessary. 13 references. (UK)

36813 SUN, ^{12}C/^{13}C ABUNDANCE RATIO AND NEUTRINO EMISSION. Raychaudhuri, Probhas (Indian Statistical Inst., Calcutta). Astrophys. Space Sci.; 13: No. 1, 231-3(Sep 1971).

It is pointed out that the effect of neutrino emission process according to the photon–neutrino coupling theory can be taken to interpret the observed ratio of ^{12}C/^{13}C abundance and other solar activities. (auth)

36814 NUCLEOSYNTHESIS OF ^{26}Al IN THE EARLY SOLAR SYSTEM AND IN COSMIC RAYS. Schramm, David N. (California Inst. of Tech., Pasadena). Astrophys. Space Sci.; 13: No. 1, 249-66(Sep 1971).

The nucleus ^{26}Al($\tau^{1/2} = 7.4 \times 10^5$ yr) has long been considered as a possible heat source during the formation of the solar system. Recent experimental work has found no evidence for ^{26}Al at the time of final solidification of the meteorites. Due to the short half-life, these measurements do not rule out the possibility that ^{26}Al was a significant heat source a few million years prior to final solidification. For ^{26}Al to be an effective heat source in the early solar system it is necessary for the ratio ^{26}Al/Si to be $\gtrsim 2 \times 10^{-7}$ at the time of a solidification. The nucleosynthetic yields of ^{26}Al by silicon burning, carbon burning, and spallation are discussed. It is shown that ^{26}Al can be synthesized in carbon and/or silicon-burning supernovae. However, time scales in the early solar system make it more likely that ^{26}Al, if present in planets, was synthesized by a proton irradiation in the early solar system. An integrated proton flux $>4 \times 10^{18}$ cm^{-2} is shown to be necessary in order for ^{26}Al to be a significant heat source. No conclusive evidence has been observed for an irradiation of this magnitude. Therefore, unless such evidence is found, it should be assumed that ^{26}Al was not involved in the formation of the solar system. In addition, the production of ^{26}Al in cosmic rays is discussed, and it is shown that either resolution of the Al isotopes in the cosmic rays or accurate measurements of the variation with energy of the cosmic-ray abundance ratios Al/Si and Mg/Si can be used to determine the "age" of the cosmic rays. Current abundance data are extremely uncertain; however, the trend tends toward values of $\gtrsim 10^6$ yr. (auth)

36815 EVIDENCE FOR THE 300-SECOND OSCILLATION FROM OSO-7 EXTREME-ULTRAVIOLET OBSERVATIONS. Chapman, Robert D.; Jordan, Stuart D.; Neupert, Werner M.; Thomas, Roger J. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 174: No. 2, L97-9(1 Jun 1972).

Evidence is presented for a 300-second oscillation in the intensity of solar extreme-ultraviolet emission lines of He II, Mg VIII, and Mg IX as observed by OSO-7. (auth)

Galaxies

Refer also to abstract 36790.

36816 STABILITY OF A UNIFORM, NON-ROTATING SPHEROID COLLAPSING UNDER ITS OWN GRAVITATION. Falle, S. A. E. G. (Univ. of Sussex, Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 265-73(1972).

The stability of a uniform, nonrotating, oblate gaseous spheroid collapsing under its own gravitation is investigated using a linearized stability analysis. The collapse is unstable in the sense that the density of a subcondensation grows relative to the mean density. The growth rate of a subcondensation is found to depend on both its shape and size. Subcondensations with dimensions larger than the initial Jeans' length grow faster than those smaller than the initial Jeans' length. Prolate subcondensations are found to grow faster than oblate ones of the same size. (auth)

36817 NITROGEN DEFICIENCY IN THE SMALL MAGELLANIC CLOUD. Sanduleak, N. (Case Western Reserve Univ., Cleveland); MacConnell, D. J.; Hoover, P. S. Nature (London); 237: No. 5349, 28-9(5 May 1972).

Some observations of the spectra of planetary nebulae in the Magellanic Clouds are described that can best be interpreted as showing an anomalous N abundance, and suggesting that the Small

Cloud (SMC) is underabundant in N relative to the Large Cloud (LMC) and the Galaxy. The observations were made with the University of Michigan Curtis Schmidt telescope at the Cerro Tololo Inter-American Observatory in Chile. This result presumably reflects an overall underabundance of N in the stellar and interstellar components of the SMC relative to the abundance in the LMC and the Galaxy. The alternative explanation that the ionized N line is not seen because an excitation effect is not favoured. The N deficiency interpretation is also supported by observations indicating that several types of stars in the SMC are metal deficient compared with their counterparts in the LMC and the Galaxy. (UK)

36818 ^{13}C ISOTOPE OF FORMALDEHYDE IN Sgr A AND Sgr B2. Whiteoak, J. B.; Gardner, F. F. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Lett.; 11: No. 1, 15-20(May 1972).

An investigation of the $C^{13}H_2O$ and $C^{12}H_2O$ absorption near Sgr A and Sgr B2 was carried out with a beamwidth of 4 arc min and filter widths of 33 and 100 kHz. The $C^{13}H_2O$ absorption for Sgr A, which is similar to the $C^{12}H_2O$ results, is associated with a continuum component located south in latitude of the overall continuum center. For Sgr B2 the absorption of both isotopes occurs possibly in three regions separated in declination; at two of the positions there is evidence of an associated continuum component. The optical depths are higher than for a uniform cloud covering the total continuum, but are consistent with a C^{12}/C^{13} abundance ratio no greater than half the terrestrial ratio. For the zero-velocity absorption, which does not occur near the galactic nucleus, the abundance ratio is at least as high as the terrestrial value. (auth)

36819 SEYFERT GALAXIES NGC 1968 AND NGC 1566. Smith, M. G. (Cerro Tololo Interamerican Observatory, La Serena, Chile); Weedman, D. W.; Spinrad, H. Astrophys. Lett.; 11: No. 1, 21-6(May 1972).

Photometric, photographic, and spectroscopic observations are presented to compare the Seyfert galaxies NGC 1068 and 1566, which are at nearly identical distances and have similar apparent diameters. Both the nuclear luminosity and the surface brightness are greater in NGC 1068. The colors of the galactic disk of NGC 1068 are significantly bluer than expected from its morphological type and the reddest part of the disk is, surprisingly, the outermost envelope. (auth)

36820 WATER-BAG MODEL IN A CYLINDRICAL TWO-DIMENSIONAL STELLAR SYSTEM. Doremus, J. P. (Univ., Nancy); Baumann, G.; Feix, M. R. Astrophys. Lett.; 11: No. 1, 37-40(May 1972).

For a rotating two-dimensional rod stellar system with cylindrical symmetry, the "water-bag" model is equivalent, in the steady state, to a polytrope of index $n = 1(\gamma = 2)$. It is shown that for this water-bag model the minimum of the total energy for a given mass and a given total angular momentum corresponds to the steady state, with uniform rotation, of the collisionless Boltzmann equation. (auth)

36821 DAMPING OF THE GALACTIC DENSITY WAVES BY THEIR INDUCED SHOCKS. Kalnajs, A. J. (Royal Greenwich Observatory, Herstmonceux, Eng.). Astrophys. Lett.; 11: No. 1, 41-3(May 1972).

The shock induced in the gaseous component of a galaxy by a tightly wrapped density wave always damps the wave. For shocks of the strength proposed by Roberts the damping times can be shorter than one galactic year. (auth)

36822 REDSHIFTS OF 27 RADIO GALAXIES. Whiteoak, J. B. (Max-Planck-Institut fuer Radioastronomie, Bonn). Aust. J. Phys.; 25: No. 2, 233-5(Apr 1972).

Spectroscopic observations of galaxies believed to be associated with radio sources were carried out over a usable spectral range of 4500 to 6700 Å from September 1968 to September 1969. (Australia)

36823 STRUCTURE IN CLUSTERS OF GALAXIES. Davis, Robert Wyatt. Gainesville, Fla.; Univ. of Florida (1971). 121p. University Microfilms Order No. 72-15,668.

Thesis.

The large discrepancy between masses of clusters of galaxies determined by using the virial theorem and that determined from the luminosity of the individual galaxies was examined to see if it is influenced by structure within the cluster in the form of fine-scale subclustering. The influence of this effect was found to be on the order of only a few percent. However, it is suggested that subclustering within a cluster will strongly influence determination of the cluster age based upon the concept of equal partition of energy. Several methods of analyzing the structure of clusters of galaxies were developed, including an improved least squares technique for developing an optimal contour map of the region of the cluster and a chi square test for a locally random distribution with a large-scale functional dependence. It was found in the case of the clusters studied, Abell 1656, Abell 2151, Abell 2199, and Abell 2256, that the degree of subclustering and the deviation from a radially dependent random distribution increased rapidly with distance in the outer regions of the cluster. This result was inconsistent with the familiar hypothesis of clusters of galaxies superimposed on a field of randomly distributed background galaxies. (Diss. Abstr. Int., B)

36824 PHOTOMETRY OF ELLIPTICAL GALAXIES IN MULTIPLE SYSTEMS. Faber, Sandra Moore. Cambridge, Mass.; Harvard Univ. (1972). 206p. University Microfilms Order No. 72-15,056.

Thesis.

Elliptical galaxies, globular clusters, and stars were observed on a 10-color intermediate-band photometric system designed for the study of the integrated spectra of old stellar populations. Measurements of standard stars were used to calibrate the system absolutely. Observations of 148 stars were used to examine the dependence of certain color indices on temperature and metal abundance. A color index straddling the blanketing discontinuity near 4000 Å was a useful indicator of metal abundance in G dwarfs of roughly solar composition. However, the interpretation of an index monitoring CN absorption as a measure of metal content in K giants is less secure. 10-color observations of 31 elliptical galaxies, largely members of double galaxies or small groups, are presented. (TSS) (Diss. Abstr. Int., B)

36825 OBSERVATIONAL STUDY OF RADIO GALAXIES. Stull, Mark Alan. Ann Arbor, Mich.; Univ. of Michigan (1971). 101p. University Microfilms Order No. 72-15,008.

Thesis.

Measurements were made of the 8000-MHz flux densities of 60 Parkes Catalogue Radio Galaxies with the University of Michigan 85-foot radio telescope. The radio spectra of these galaxies were formed by combining the 8000-MHz data with as many flux density measurements at frequencies between 10 and 10,000 MHz as could be found for them in the literature. The principal conclusion concerning the spectra of the galaxies may be summarized as follows: (1) When spectra of radio galaxies are extended to 8000 or 10,000 MHz, the proportion of curved spectra which belong to class C^+ increases over that found in surveys at lower frequencies. (2) Spectral curvature is more readily detected when one has a large number of flux density measurements over a wide range of frequencies. (3) Complex spectral curvature is rare. The spectra of all the galaxies in this sample can be represented by simple first and second order curves. (4) The correlation between spectral index and luminosity reported by Kellermann, Pauliny–Toth, and Williams (1969) is also found at 250 MHz, but not at 8000 MHz. One of the galaxies, PK 0048-09, was found to be a radio variable. This is important since radio variations have been reported in only about half a dozen galaxies. Moreover, PK 0048-09 varies in an unusually rapid manner; in 1970 three distinct outbursts took place. Its spectrum lacks a low-frequency component and in this respect it resembles another rapidly varying radio source, BL Lacertae. (Diss. Abstr. Int., B)

36826 IMAGE-TUBE PHOTOMETRY OF CLUSTERS OF GALAXIES. Gudehus, Donald Henry. Los Angeles; Univ. of California (1971). 288p. University Microfilms Order No. 72-13,610.

Thesis.

A method of photometry was developed whereby the surface fluctuations in sensitivity of the image tube are taken account of. Internal consistencies of $\sigma = \pm 0.11$m were attained for reference stars as faint as $V = 15$ and $\sigma = \pm 0.3$m for stars as faint as $V = 19$. The method is easily extended to extrafocal photometry of galaxies and was used to determine the luminosity functions of the central regions of the rich Abell Clusters 2065, 1367, and 754. (TSS) (Diss. Abstr. Int., B)

36827 POLARIZATION AT 4430 A. Kelly, Alison (Univ. of Edinburgh). Astrophys. Space Sci.; 13: No. 1, 211-18(Sep 1971).

The wavelength dependence of polarization in the region of the interstellar absorption and at 4430 Å was investigated theoretically by variation of the relevant parameters over a wide range. Comparison was made with observations, and the suggestion that the 4430-Å band is produced by impurities in a silicate matrix was found to be not inconsistent. (auth)

36828 INTERFEROMETRIC STUDY OF THE MILKY WAY BETWEEN CARINA AND AQUILA. Dottori, H.; Carranza, G.

(Observatorio Astronomico, Cordoba, Argentina. CNICT, Buenos Aires). Astrophys. Space Sci.; 13: No. 1, 180-4(Sep 1971).

Large field Hα observations of the Milky Way between Carina and Aquila were made through a narrow interference filter 15-Å wide. Characteristic large-scale features of the observed region are extended emission areas in Carina, Norma–Scorpius, and Scutum–Sagittarius and some weak isolated nebulosities near the Coalsack, α Centauri, and γ Normae. Hα photographs, a chart mapping the emission, and a list of identified emission regions are given. (auth)

36829 OUTER SPIRAL STRUCTURE AND HIGH VELOCITY CLOUDS IN THE GALAXY. Davies, R. D. (Univ. of Manchester, Jodrell Bank, Eng.). Nature (London); 237: No. 5350, 88-91(12 May 1972).

New observations of the high-velocity clouds found in neutral hydrogen surveys of the Galaxy show that these may be interpreted in terms of an extension of the outermost spiral arm, confirming and extending the model of Habing (Bull. Astron. Inst. Netherlands, 18: 323(1966)). (auth)

36830 POLARIZATION CLOUDS AND DYNAMICAL FRICTION. Kalnajs, Agris J. (Harvard Coll. Observatory, Cambridge, Mass.). Astrophys. Space Sci.; 13: No. 2, 279-83(Oct 1971).

It is argued that dynamical friction can be viewed as the drag exerted on a "test" star by the wake it induces in the field stars. The wakes were computed for the uniform infinite medium and a flat rotating sheet. In the first case a result was obtained that differs by a factor of two from the classical result. In the second case the drag vanished. (auth)

36831 X-RAY EMISSION FROM THE GALACTIC DISK. Bleach, R. D.; Boldt, E. A.; Holt, S. S.; Schwartz, D. A.; Serlemitsos, P J. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J.; 174: No. 2, L101-6(1 Jun 1972).

A search was made for a diffuse component of x rays >1.5 keV associated with an interarm region of the Galaxy at galactic longitudes in the vicinity of 60°. A statistically significant excess associated with a narrow disk component was detected. The angular extent of this component has a most probable value of 2° and may be as large as 7° at 90% confidence. The best-fit spectrum yields an intensity of 2.9 photons cm^{-2} s^{-1} $sterad^{-1}$ over the 2- to 10-keV range. The 3 σ upper limit to any emission (e.g., iron line) in a 1.5-keV band centered at 7 keV from galactic latitudes $|b| \leq 3.5°$ is 0.3 photons cm^{-2} s^{-1} $sterad^{-1}$. Several possible emission models are evaluated, with the most likely candidate being a population of unresolvable low-luminosity discrete sources. (auth)

36832 EXTENDED X-RAY SOURCE AT M87. Kellogg, E.; (American Science and Engineering, Cambridge, Mass.); Gursky, H.; Tananbaum, H.; Giacconi, R.; Pounds, K. Astrophys. J.; 174: No. 2, L65-9(1 Jun 1972).

The strongest x-ray source in the Virgo cluster is extended by about 1° and centered on M87. Its spectrum fits a power law of energy index $-(2.06 \pm 0.10)$. There is no other evidence for x-ray emission from Virgo except for the weak discrete source 2U 1231 + 7. This gives a limit of 2×10^{40} ergs s^{-1} for the x-ray luminosity of an average galaxy in the Virgo cluster. (auth)

36833 DUST NEAR THE CENTER OF M31. Johnson, Hugh M. (Lockheed Missiles and Space Co., Palo Alto, Calif.); Hanna, Mark M. Astrophys. J.; 174: No. 2, L71(1 Jun 1972).

Specially processed copies of a plate show the dust. (auth)

Cosmology

Refer also to abstract 37333.

36834 COMMENTS ON THE INSENSITIVITY OF (V/V_m) TO RANDOM SHUFFLING OF THE REDSHIFTS IN THE LUMINOSITY-VOLUME TEST. Carswell, R.; Weymann, R. (Univ. of Arizona, Tucson). Mon. Notic. Roy. Astron. Soc.; 156: No. 3, 19P-23P(1972).

Several artificial luminosity functions are considered in an Einstein–de Sitter cosmological model and the values of (V/V_m) for the "actual" and "shuffled" luminosity functions are computed. The relative insensitivity of (V/V_m) to the complete shuffling of the redshifts is shown to be a very general property, even for quite contrived luminosity functions in which there is a strong correlation between flux and redshift. (auth)

36835 ANALYSIS OF X-RAY BACKGROUND FLUCTUATIONS. Fabian, A. C. (University Coll., London). Nature (London) Phys. Sci.; 237: No. 71, 19-21(8 May 1972).

An analysis of the x-ray background similar to that used in log N–log S plots familiar from radio work shows that an origin in clusters of galaxies cannot be ruled out. (auth)

36836 RADIATION PRESSURE ON A TEST PARTICLE IN GENERAL RELATIVITY. Noerdlinger, P. D. (Michigan State Univ., East Lansing). Nature (London); 237: No. 5349, 30-1 (5 May 1972).

The acceleration of a particle to relativistic velocities by radiation pressure in an inverse square radiation field, with the gravitational force neglected, is discussed, with particular reference to the gas in or near QSOs. It is stated to be possible that a small portion of the redshifts of QSO's may be gravitational, and also likely that highly ionized materials lie close to the central source, where the effects of general relativity are larger. For stationary particles the force of radiation pressure varies more rapidly than that of gravity with changing distance to the central source. This makes stable equilibria possible. (UK)

36837 DIRECTION OF INFORMATION PROPAGATION AND COSMOLOGY. Pegg, D. T. (James Cook Univ. of North Queensland, Townsville, Australia). Aust. J. Phys.; 25: No. 2, 207-14 (Apr 1972).

In conventional electrodynamic theory, the advanced potential solution of Maxwell's equations is discarded on the ad hoc basis that information can be received from the past only and not from the future. This difficulty is overcome by the Wheeler–Feynman absorber theory, but unfortunately the existence of a completely retarded solution in this theory requires a steady-state universe. In the present paper conventional electrodynamics is used to obtain a condition which, if satisfied, allows information to be received from the past only, and ensures that the retarded potential is the only consistent solution. The condition is that a function U^a of the future structure of the Universe is infinite, while the corresponding function U^r of the past structure is finite. Of the currently acceptable cosmological models, only the steady-state, the open big-bang, and the Eddington–Lemaître models satisfy this condition. In these models there is no need for an ad hoc reason for the preclusion of advanced potentials. (auth)

36838 PHYSICAL COSMOLOGY. Peebles, P. J. E. Princeton Series in Physics. Princeton, N. J.; Princeton University Press (1971). 295p. $9.00.

An introduction to the elements of classical cosmology is given. Topics discussed in individual chapters include homogeneity and isotropy of the Universe, Hubble's constant and the cosmic time scale, mean mass density of the Universe, microwave background and the primeval fireball hypothesis, cosmological models, history of the Universe, and primeval helium. (W.D.M.)

36839 EFFECT OF ENERGY LIBERATION ON THE EMISSION SPECTRUM IN A HOT UNIVERSE. Zel'dovich, Ya. B.; Illarionov, A. F.; Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1217-27(Apr 1972). (In Russian).

An isotropic radiation field is considered whose spectrum is a linear superposition of Planck spectra with various temperatures. It is demonstrated that it is precisely this type of distortion of the relict blackbody radiation that is produced by various mechanisms of energy evolution at early stages of expansion of the Universe, e.g., energy dissipation in adiabatic perturbations of matter density, in primary turbulence, annihilation of matter and antimatter, etc. The same type of spectrum can also be the result of "comptonization" of the Planck spectrum after multiple Compton scattering of low-temperature blackbody radiation by "hot" electrons such that $T_e \gg T_r$. The equilibrium temperature of electrons in such a radiation field is calculated. It naturally exceeds the initial (prior to heating) radiation temperature as well as the stationary brightness radiation temperature in the Rayleigh–Jeans spectral range after heating. The brightness temperature of the bremsstrahlung radiation of an optically thick ionized gas in the decimeter wave band is equal to the electron temperature, i.e., it exceeds the brightness temperature in the centimeter range. The absence of an appreciable difference between the relict radiation temperatures in these wavelength regions indicates that the amount of energy evolved in the Universe at a time corresponding to redshifts $1.5 \times 10^3 < z < 10^4$ did not exceed 5% of the energy in the radiation. (auth)

36840 TENSOR–TENSOR THEORY OF GRAVITATION. Firmani, Claudio (Univ. Nacional Autonoma de Mexico, Mexico City). Astrophys. Space Sci.; 13: No. 1, 128-6(Sep 1971).

One approach to a tensor–tensor theory of gravitation is proposed as an attempt to represent Mach's principle in a consistent way. In this theory the geometrodynamic properties of general relativity are still valid, but not necessarily its field equations. Einstein's equations may be obtained as a special case. (auth)

36841 SOME REMARKS ON THE UNIVERSAL X-RAY BACKGROUND. Raychaudhuri, Probhas; Bandyopadhyay, Pratul (Indian Statistical Inst., Calcutta). Astrophys. Space Sci.; 13: No. 1, 185-8(Sep 1971).

It is shown that a universal steady x-ray background with the energy flux $\simeq 10^{-7}$ erg cm^{-2} s^{-1} sr^{-1} can arise as a superposition of radiation from pulsars (neutron stars) in various galaxies when it is taken into account that supernova outburst occurs in a galaxy at the rate of 10^{-2}/year. (auth)

36842 COSMIC BACKGROUND RADIATION AT 1.32 mm. Hegyi, D. J. (Boston Univ.,); Traub, W. A.; Carleton, N. P. Phys. Rev. Lett.; 28: No. 23, 1541-4(5 Jun 1972).

The position of the R(0), R(1), and R(2) lines of the 3874-Å band of interstellar CN in the spectrum of the star ζ Ophiuchi were scanned with a Fabry–Perot interferometer. The Doppler width (full width at half-maximum) of the R(0) line is 28 mÅ. At the expected position of the R(2) line an absorption feature was found with an equivalent width of 0.077 ± 0.055 mÅ which implies a temperature of $2.9^{+3.4}_{-2.1}$ K for the cosmic background radiation at 1.32 mm. A conservative interpretation of the data is simply to give an upper limit (2σ) of 3.8 K to this temperature. (auth)

Planetary Phenomena

36843 DECAMETRIC RADIO EMISSION OF JUPITER AS INDICATOR OF HIGH-VELOCITY FLUXES AND SHOCK-WAVES IN THE SOLAR WIND. Kovalenko, V. A.; Malyshkin, V. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 747-9(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 888-90(1971).

The average velocities of fluxes and shock waves in the solar wind have been determined at distances of 1 to 5.2 AU during a period of high solar activity. Now a period of solar minimum activity is investigated. The period involved 98 days from Sept.–Dec. 1964. Strong geomagnetic disturbances and correspondingly prolonged radio bursts on Jupiter are typical of Sept.–Oct., whereas geomagnetic disturbances and the radio activity of Jupiter are markedly weaker in Nov.–Dec. A relationship is established and makes it possible to determine the average velocity of the fluxes and shock waves at a distance of 1 to 5.2 AU from the delay of radio bursts from Jupiter with respect to the corresponding geomagnetic disturbances. Some 1960 data are given and compared with the results. Thus, results show that during a solar-activity minimum the geophysically active fluxes and shock waves that cross the magnetosphere of Jupiter produce radio bursts in the decameter range. (J.C.W.)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

36844 (EGG–1183-5009) OPERATION BARBIZON RADIOMETRIC CALIBRATION DATA. Bunker, F. J. (EG and G, Inc., Los Alamos, N. Mex.). Mar 1972. Contract AT(29-1)-1183. 57p. Dep. NTIS.

For Los Alamos Scientific Lab., N. Mex.

Operation BARBIZON is a series of high altitude rocket experiments which were conducted during October–November 1971 near the Hawaiian Islands. This report is a compilation of the radiometric calibration data for the EG&G photographic instrumentation on the two diagnostic aircrafts, A/C 369 and A/C 370. The purpose of this compilation is to provide ready access to the radiometric calibration information that must be known in order to analyze the Operation BARBIZON optical film records. (auth)

36845 (LA-tr–72-5) MONOCHROMATIC MORPHOLOGY OF POLAR AURORAS FROM DATA OF THE PATROL SPECTROGRAPH IN MURMANSK. Evlashin, L. S. Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from Polyar. Siyaniya; No. 19, 12-26(1970). 42p. Dep. NTIS.

On the basis of the analysis of space–time distribution of different types of auroras and their association with parameters of the disturbed ionosphere and the geomagnetic field, the degree of characteristic changes of the streams of particles causing aurora during maximum to minimum solar activity is determined. During that period the properties of these streams showed considerable changes. The intensity of the electron and proton streams precipitating in the zone of maximal aurora recurrence subsided considerably toward the years of the minimum of solar activity. The energy spectrum of the proton streams practically did not change. The energy spectrum of electrons, being very wide in the years of the maximum, became more monochromatic as the result of a considerable reduction of the low-energy part of the electron streams. The character of space–time relations of the electron and proton streams in the Earth's atmosphere remains unchanged during several years from the maximum to the minimum of solar activity. (auth)

36846 ELECTROSTATIC INSTABILITY EXCITED BY AN ELECTRON BEAM TRAPPED IN THE MAGNETIC MIRROR OF THE MAGNETOSPHERE. Nishihara, Katsunobu; Hasegawa, Akira; Maclennan, C. G.; Lanzerotti, L. J. (Bell Telephone Labs. Inc., Murray Hill, N. J.). Planet. Space Sci.; 20: No. 5, 747-59(May 1972).

A dispersion relation which takes into account the nonuniformity of the magnetic field as well as the plasma density along the field lines is obtained for an electrostatic wave propagating parallel to the magnetic field. This dispersion relation is solved for a particular case in which a group of electrons with a monochromatic distribution in magnetic moment is mixed with a low-energy plasma. Such electrons are shown to excite ion-acoustic waves carried by the low-energy plasma component near multiples of the bounce frequency of these electrons. The theoretical results are applied to explain electrostatic oscillations with a period of approximately fifty seconds observed in the high-energy electron fluxes at synchronous altitude. (auth)

36847 EFFECT OF THE RING CURRENT ON WHISTLER PROPAGATION IN THE MAGNETOSPHERE. Sagredo, J. L.; Bullough, K. (Univ. of Sheffield, Eng.). Planet. Space Sci.; 20: No. 5, 731-46(May 1972).

The propagation of whistlers in a disturbed magnetosphere was studied. The disturbance was that produced by a ring of charged particles encircling the Earth with a maximum in energy density at three earth radii. The ring-current model adopted [Sozou and Windle, (Planet. Space Sci. 17: 375 and 989 (1969))] takes into account the self-effect of the magnetic field of the ring-current particles in their own motion. It is found that the presence of the ring current changes both the nose frequency, f_n, and the travel time at the nose frequency, t_n, of a whistler. The distortion of the magnetic field alters the relationship between the f_n of a whistler, the equatorial distance of its path of propagation, and the geomagnetic latitude at which the field line is anchored. It is shown that this may account, at least in part, for the apparent decrease in electron density during disturbed periods deduced from whistler analysis by Carpenter (J. Geophys. Res., 67: 135 (1962)). In addition, account should be taken of the effect of field line distortion when determining the location of the knee during disturbed periods. Thus, the discrepancy found by Rycroft and Thomas (Planet. Space Sci. 18: 65(1970)) between the position of the medium latitude trough and that, determined from whistler analysis, of the plasmapause is probably due to this effect. (auth)

36848 AMPLIFICATION OF WHISTLER WAVES IN THE MAGNETOSPHERE. Ashour-Abdalla, M. (Imperial Coll. of Science and Tech., London). Planet. Space Sci.; 20: No. 5, 639-62(May 1972).

The effect of a succession of narrow-band Morse pulses, propagating in the whistler mode, on a steady-state distribution function of electrons trapped in the Earth's magnetic field was studied. The pulses have the effect of diffusing the particles in both pitch angle and energy, and the corresponding pitch-angle diffusion coefficients and energy diffusion coefficients were computed. Because of the definite relation between the changes in magnetic moment and energy of a particle which occur at resonance, particles are forced to move on given surfaces in velocity space, so that the diffusion is one-dimensional. The corresponding single diffusion coefficient was computed and a one dimensional Fokker–Planck equation derived. A Kennel and Petschck (J. Geophys. Res., 71: 1 (1966)) type initial distribution function was used and a time development of this distribution function is considered. It is found that a slot develops in the distribution function at a velocity corresponding to the frequency of the Morse pulses. Growth rates for the modified distribution function are computed, and the behavior of the growth rates leads to postulation of a mechanism for the explanation of the artificially stimulated emissions. The mechanism explains some of the important observational results for ASE, such as the offset frequency and the fact that emissions are often triggered near the equator. An extension of this work may also explain the observed preferential triggering at half the minimum gyrofrequency. (auth)

36849 IONOSPHERIC PLASMA RESONANCES: TIME DURATIONS VS. LATITUDE, ALTITUDE, AND f_N/f_H. Benson, Robert F. (Goddard Space Flight Center, Greenbelt, Md.). Planet. Space Sci.; 20: No. 5, 683-706(May 1972).

The variation of resonant time duration with latitude, altitude, and f_N/f_H was determined for the plasma resonances observed by Alouette I and II at the electron plasma frequency f_N, the electron cyclotron frequency f_H, the upper hybrid frequency f_T, and the harmonics nf_H where n = 2,3 ... . The long duration form of the f_N resonance (which is required in order to make electron temperature measurements based on the oblique echo theory) is only observed when the transmitted sounder power is greater than approximately 0.5 W. The f_H resonance has a time duration longer than any of the nf_H resonances in a rare plasma (about 10^3 electrons/cm^3); in a dense plasma (about 10^5 electrons/cm^3), on the other hand, it is one of the weakest resonances observed. The 2 f_H resonance is the only nf_H resonance that does not show a definite dependence of duration on latitude and the only one that shows a strong dependence on f_N/f_H; the other nf_H resonances show a definite dependence on altitude (as well as latitude). The resonances at 3 f_H and 4 f_H are observed strongest at high altitudes whereas the high order harmonics are consistently observed only at low altitudes. The nf_H observations with $n > 5$ are consistent with a stationary resonant region, extending only about 2 meters from the antenna, that is observed during its full time decay period (up to a few msec) in low latitudes; the observations are limited in high latitudes by the motion of the satellite. The results show that neither the theory based on longitudinal plasma waves with low group velocity excited by an infinitesimal dipole (which predicts much longer time durations) nor the theory based on magnetic field nonuniformity limitations of non-longitudinal plasma waves propagating with a group velocity matched to the satellite velocity gives a proper interpretation of the high order nf_H resonance observations. (auth)

36850 THERMAL PLASMA DENSITIES DETERMINED FROM DIGITAL SONAGRAMS OF HYDROMAGNETIC WHISTLERS. Higuchi, Y.; Kisabeth, J. L.; Jacobs, J. A. (Univ. of Alberta, Edmonton). Planet. Space Sci.; 20: No. 5, 707-10(May 1972).

A new method is described of obtaining thermal plasma densities in the magnetosphere from digital sonagrams of hydromagnetic whistlers. More accurate densities can be obtained by this method than by using analog sonagrams. (auth)

36851 ELECTRON DENSITY MEASUREMENTS IN THE IONOSPHERE USING A RADIO PROPAGATION METHOD. Beynon, W. J. G. (University Coll. of Wales, Aberystwyth); Maude, A. D.; Ratcliff, G. Planet. Space Sci.; 20: No. 5, 809-19(May 1972).

A rocket C–W radio propagation experiment was used to measure electron density profiles and the results compared with values calculated from ionograms. In general, the agreement was satisfactory, but significant discrepancies in the rocket measurements, during the up-leg portions of several rocket flights above 110 km, were observed and possible causes are discussed. In one flight the effect of a traveling ionospheric disturbance on the N(h) profile was recorded. Sporadic-E strata with thicknesses of 0.6 to 0.8 km were recorded in these flights. (auth)

36852 PHOTOGRAPHS OF THE FRONT OF THE EXPANDING AURORAL BULGE DURING AN AURORAL SUBSTORM. Akasofu, S. L. (Univ. of Alaska, [College]). Planet. Space Sci.; 20: No. 5, 821-2(May 1972).

It is stated that the poleward expansive phase of auroral substorms in the midnight sector is associated with one of the most spectacular types of auroral displays. Good photographs of the expanding auroral bulge, however, are rather scarce. Some excellent photographs of the fronts of the expanding bulges were, however, obtained during the 1968 NASA Airborne Expedition; these are reproduced and show many of the common features of the expanding bulges, such as violent curl motions of auroras and the formation of new arcs at the front of the expanding bulge and north—south aligned arcs just inside the bulge. (UK)

36853 EFFECT OF DEPARTURES FROM SPHERICAL SYMMETRY UPON THE BISTATIC-RADAR OCCULTATION EXPERIMENT. McCormick, P. T. (Univ. of Santa Clara, Calif.); Whitten, R. C. Planet. Space Sci.; 20: No. 5, 822-5 (May 1972).

It has been found that the conversion of residual Doppler data obtained in occultation experiments into electron density profiles under the assumption of a spherically symmetric model atmosphere and ionosphere can, under certain conditions, lead to serious errors. These errors are discussed. Asymmetric steady-state electron number density profiles for Mars were calculated, assuming pure CO_2 as a model atmosphere, with a surface pressure of 5 mb and a temperature profile based on Mariner IV observations. The two-frequency bistatic radar occultation method (Fjeldbo, J. Geophys. Res., 70: 3701 (1965)) was applied to a simulated occultation. (UK)

36854 OBSERVATIONS OF PLASMA WAVES GENERATED BY A BEAM OF ELECTRONS IN THE IONOSPHERE. Cartwright, David Geoffrey. Minneapolis; Univ. of Minnesota (1971). 146p. University Microfilms Order No. 72-14,280.
Thesis.

A controlled experiment on wave—particle interactions in the ionosphere was made. Pulses of electrons of 40 kV and 70 mA were emitted from a rocket-borne accelerator and injected into the Earth's magnetic field with pitch angles near 90°. The pulses were 16 ms long, emitted in a repetitive cycle of 10/s for 12 s then 1/s for 6 s; a total of about 3,000 pulses was emitted. The ejected fiberglass nose cone of the rocket carried antennas and receivers to measure the electric field of waves generated by the beam. Wide-band receivers telemetered to the ground the waveform of signals between 16 Hz and 10 kHz and a sweep frequency spectrum analyzer telemetered the amplitude of signals between 100 kHz and 10 MHz. Associated with the electron beam, emissions were detected at frequencies near the plasma frequency of the ionospheric electrons, near the second harmonic of the electron cyclotron frequency, in the whistler mode (below the electron cyclotron frequency) and near zero frequency. Associated with the operation of an argon plasma generator used to keep the accelerator neutralized, continuous emissions were detected near the lower hybrid resonance frequency of the background ionosphere. All of these wave modes have low phase velocities and hence can interact strongly with the emitting particles. For some of the wave modes, calculations are presented of the incoherent Cherenkov—cyclotron radiation expected from the particles. The calculations show that not all of the emission features can be accounted for by incoherent processes, so that some coherent emission or instabilities may be required to fully explain the observations. The observations show that the beam does not lose a significant amount of energy to wave generation processes. (Diss. Abstr. Int., B)

36855 USE OF THE THIRTEEN-MOMENT APPROXIMATION TO DESCRIBE THE PROPAGATION AND INTERACTION OF ELECTROMAGNETIC WAVES IN THE IONOSPHERE. Rigby, Robert Norris. Tallahassee; Florida State Univ. (1968). 217p. University Microfilms Order No. 72-13,558.
Thesis.

The validity and utility of the thirteen-moment approximation for describing the behavior of the electrons in an ionized gas in the presence of electric and magnetic fields were investigated. General expressions for electron transport coefficients were obtained using the thirteen-moment approximation. The results were applied to the particular cases of ionized nitrogen, hydrogen, deuterium, oxygen, helium, argon, krypton, and xenon in the presence of a strong static electric field. The cross sections obtained by Phelps' group at the Westinghouse Research Laboratory were used, and the results were compared with the experimental measurements of the same group. The agreement ranged from fair to excellent depending on the relative magnitudes of the inelastic cross sections at different electron energies. The thirteen-moment approximation was also used to calculate the complex index of refraction for an electromagnetic wave propagating through an ionized gas in the presence of a static magnetic field. For a velocity dependent cross section similar to that of nitrogen, the results agreed well with those obtained by Sen and Wyler using generalized Appleton—Hartree magnetoionic formulae. From the above results it was concluded that the thirteen-moment approximation can provide a fairly accurate method of theoretically handling the interaction of electromagnetic waves in the ionosphere (the Luxembourg effect). The thirteen-moment approximation was therefore applied to the problem of cross modulation in the ionosphere. The results were compared with those calculated by Benson. Significant differences were found which suggest that the phenomenological electron energy loss terms used by Benson are unable to handle inelastic processes in the ionosphere. (Diss. Abstr. Int., B)

36856 THEORY OF IONOSPHERIC IRREGULARITIES IN EQUATORIAL ELECTROJET PLASMA. Akinrimisi, Jibayo. Ithaca, N. Y.; Cornell Univ. (1971). 140p. University Microfilms Order No. 72-13,144.
Thesis.

Theoretical studies on low-frequency electrostatic gradient-driven instabilities and their nonlinear evolution are undertaken to explain the production of ionospheric irregularities associated with the equatorial electrojet. In order to account for ionospheric irregularities of the secondary-type (Type II) instabilities that occur for electrojet velocities much less than the acoustic velocity, instabilities driven by gradients in drift velocity, ionization density, collision frequency, and magnetic field were considered. The most important instability in this respect appears to be that due to ionization density gradient, but wavelengths at marginal instability are too long to explain irregularities causing radar backscatter at 50 MHz. The observations can be explained in terms of nonlinear transfer of energy from long-wavelength linearly unstable modes to shorter-wavelength modes. A nonlinear partial differential equation is developed to describe the evolution of instability in the nonlinear regime. Numerical solutions of this equation on a digital computer show that it is possible to transfer energy to the shorter wavelengths in times of the order of tens of seconds. (Diss. Abstr. Int., B)

36857 SPECTROPHOTOMETRY OF THE AURORA. Harrison, A. W. (Univ. of Calgary, Alberta). Can. J. Phys.; 50: No. 5, 500-5(1 Mar 1972).

Systematic spectrophotometric measurements of the auroral spectrum in the (S-1) region and of the O I (5577) line involving digital-recording and computer-averaging techniques, and coupled with reliable background-airglow subtraction, led to brightness determination of the O I (8446) line and O_2 At (0—1), N_2 1PG, and N_2^+ M bands in agreement with current predictions. (auth)

36858 STUDY OF ION-PAIR PRODUCTION RATES AND ELECTRON NUMBER DENSITIES IN THE IONOSPHERIC D-REGION. Folkestad, K.; Thrane, E. V.; Landmark. B. (Norwegian Defence Research Establishment, Kjeller). J. Atmos. Terrest. Phys.; 34: No. 6, 963-8(Jun 1972).

The objective was to explore how the quantities $q/(1 + \lambda)$ and N_e^2 are related at 74 and 80 km. Ground-based and rocket measurements were used in the analysis. The results indicate significant deviations from a "classical" square-law dependence. A better representation is offered by the two-ion model suggested by Haug and Landmark (J. Atmos. Terrest. Phys. 32: 405(1970)). q denotes the ion-pair production rate, N denotes the electron number density, and λ specifies the ratio between the number densities of negative ions and electrons. (auth)

36859 ION CHEMISTRY AND THERMAL BALANCE OF THE E- AND LOWER F-REGIONS OF THE DAYTIME IONOSPHERE: AN EXPERIMENTAL STUDY. Timothy, Adrienne F. (University Coll., London. Mullard Space Science Lab., Holmbury, Eng.); Timothy, J. G.; Willmore, A. P.; Wager, J. H. J. Atmos. Terrest. Phys.; 34: No. 6, 969-1035(Jun 1972).

The processes of heating and ionization in the E and F regions of the daytime ionosphere are discussed in depth. Construction of a sounding-rocket payload, consisting of an assembly of extreme ultraviolet (euv) spectrometers and plasma probes designed for simultaneous measurement of related ionospheric parameters, is described, and results obtained from a flight of this payload on a Sun-pointing Skylark sounding rocket at Woomera, S. Australia on

April 3, 1969 are presented in detail. The derivation of neutral atmosphere densities and temperatures from the spectrometer data is defined, and the values obtained for ion production rates due to the absorption of solar euv radiation in the 100 to 270 km range are presented. Based on these data, individual ion densities and the ambient electron temperatures are calculated, assuming quasi-static equilibrium. The value of the effective loss coefficient determined over this altitude range is 1×10^{-7} cm^{3}sec^{-1} at 120 km and 2.2×10^{-3} sec^{-1} at 270 km. Above 130 km the calculated total ion density agrees with the measured electron density to within 30% below this altitude the calculated density diverges, becoming a factor of 2 too low at 120 km. The measured value of the electron temperature is found to be greater than the neutral temperature at all altitudes in the 120 to 270 km range. This thermal imbalance can be explained on the basis of the measured solar euv heat input at all altitudes above about 140 km. To account for thermal anomalies at lower altitudes, however, it is necessary to postulate an additional heat source capable of raising the electron temperature above the neutral temperature. (auth)

36860 ANNUAL AND SEMIANNUAL VARIATIONS OF THE THERMOSPHERIC DENSITY. Volland, H.; Wulf-Mathies, C.; Priester, W. (Univ., Bonn). J. Atmos. Terrest. Phys.; 34: No. 6, 1053-63(Jun 1972).

The semiannual density variation is decomposed into Fourier terms to study the physical nature of this effect. In order to represent the observational data of the semiannual effect it is sufficient to take into account the first two harmonics—the annual and the semiannual components. From satellite drag observations different height profiles for the two Fourier components were deduced that suggest that the components originate from different energy sources. The annual component is mainly due to the varying solar heat input into the ozone layer according to the changing Earth–Sun distance during the orbital motion of the Earth. This heat input into the ozone layer generates thermally excited planetary waves leaking into the thermosphere. The amplitude of this annual wave remains nearly constant over thermospheric heights. The semiannual component may be explained by varying Joule heating at thermospheric altitudes and by tidal and gravity waves from the lower atmosphere, the wave energy of which is dissipated within the lower thermosphere with a period of ½ yr. The amplitude of the thus-generated semiannual wave increases with height. (auth)

36861 SUDDEN DECREASE OF ATMOSPHERICS AT 5 kHz. Triska, P.; Lastovicka, J (Geophysical Inst., Prague). J. Atmos. Terrest Phys.; 34: No. 6, 1065-73(Jun 1972).

Solar flare effects—involving sudden decreases of atmospherics—at 5 kHz have been observed since 1962 at the Panská Ves observatory. A review of SDA's observed on the records of the integrated atmospheric noise level is given for the period 1962–1969. The occurrence of SDA's was almost the same for maximum and medium solar activity. The maximum relative occurrence frequency of SDA with regard to all SID's (sudden ionospheric disturbances) observed (as high as 22.5 percent) was found for medium solar activity. The average relative occurrence frequency of SDA was found to be 11.3 percent. Several events accompanied by SDA and by other types of SID, but not by SEA (sudden enhancements of atmospherics) (at 27 kHz) were observed. On the other hand, three events were accompanied by SDA (5 kHz) and SEA (27 kHz) only. An attempt is made to explain qualitatively both types of events on the basis of variable propagation conditions. (auth)

36862 MAGNETO-IONOSPHERIC EFFECT OF THE SUBSTORM. Pushkova, G. N.; Yudovich, L. A.; Petviashvili, V. I ; Feldshtein, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Moscow). J. Atmos. Terrest. Phys.; 34: No. 6, 1097-1103(Jun 1972).

Observations of the geomagnetic substorm of Oct. 21, 1964 made at Moscow are compared with ionograms recorded at the same place and time. The currents flowing in the dynamo region were deduced from the magnetic-field variations and were used in conjunction with the integrated Hall and Pedersen conductivities, calculated from the ionograms, to deduce the electric field in the dynamo region. It is shown that, if these electric fields were transmitted to the F region, they would produce height changes of that region about 10 times greater than are deduced from the ionograms. It is suggested that in middle latitudes the origin of the magnetic-field disturbances during a substorm is not mainly in the dynamo region, but is outside it and is possibly related to currents along geomagnetic-field lines. (auth)

36863 DEPENDENCE OF THE DAILY RANGES OF GEOMAGNETIC VARIATIONS ON A_p. Kane, R. P. (Physical Research Lab., Ahmedabad, India). J. Atmos. Terrest. Phys.; 34: No. 6, 1105-17(Jun 1972).

After applying D_{st} corrections, the daily range of geomagnetic H variation at Trivandrum (Equator) and Alibag (midlatitude) is separated into a positive (ΔSd^+) and a negative (ΔSd^-) component. Correlations of these between themselves, and with geomagnetic activity index A_p, are studied. It is found that on a majority of quiet days (A_p = 0 to 7) only the positive component exists and is poorly correlated with A_p (as also at different latitudes). For disturbed days the negative component is large, well correlated at different latitudes and moderately correlated with A_p, but poorly correlated with the positive component. Several other details are presented as evidence to indicate that the negative component may be of magnetospheric origin while the positive component may have magnetospheric as well as ionospheric origins, in different proportions in different seasons and at different latitudes. (auth)

36864 DEPENDENCE OF CALCULATED INTEGRATED PRODUCTION RATES ON SOLAR ACTIVITY. Spurling, P. H. (Univ. of Queensland, St. Lucia, Australia). J. Atmos. Terrest. Phys.; 34: No. 6, 1151-3(Jun 1972).

The integrated production at sunrise, $Q_{90}[0^+]$, was calculated for the period October 1969–September 1970 using the model of Smith (J. Geophys. Res. 73: 7385(1968)). Using these values, together with the production rates calculated by Smith, a linear relation was calculated between the production rate and the solar 10.7-cm flux, $S_{10.7}$. (auth)

36865 METHOD FOR ESTIMATION OF F-REGION VERTICAL VELOCITIES FROM NIGHTTIME N–h PROFILES. Krishna Murthy, B V.; Sen Gupta, K. (Space Science and Tech., Centre, Trivandrum, India). J. Atmos. Terrest. Phys.; 34: No. 6, 1155-9(Jun 1972).

A method of estimating the F-region vertical velocities from electron density–true height profiles is presented. The conditions under which this method is applicable are discussed. Using this method some nighttime velocity–height profiles are estimated. (auth)

36866 MID-LATITUDE VLF EMISSIONS AND THE MECHANISM OF DAYSIDE AURORAL PARTICLE PRECIPITATION. Hargreaves, J. K. (Univ. of Lancaster, Eng.); Bullough, K. Planet. Space Sci.; 20: No. 5, 803-7(May 1972).

Simultaneous observations of vlf noise on the satellite Ariel 3 and of daytime auroral radio absorption at a high-latitude station are interpreted to show a linear relationship between the flux of auroral particles and the intensity of midlatitude vlf emissions. The results are consistent with particle precipitation by a process of weak pitch-angle diffusion. At fluxes near the theoretical trapping limit the pitch-angle distribution becomes isotropic, as would be expected in strong diffusion, but this corresponds to a high level of radio absorption that is observed only infrequently. It is concluded that weak diffusion is the operative mechanism in most cases. (auth)

36867 IONIZING RADIATION AT HEIGHTS OF 200 TO 300 KM. Maduev, V. L.; Makhmudov, B. M.; Kuznetsov, S. N. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 659-62(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 771-5(1971).

The data obtained on Cosmos 228 were used to construct the differential energy spectra of electrons with energies 60 to 450 keV in the inner belt for L = 1.25 to 1.75 and B = 0.23 to 0.24 gauss and in the outer belt for L = 3.5 to 5.0 and B = 0.38 to 0.49 gauss. The fluxes of precipitating and quasitrapped particles are also investigated in the interval L = 1.1 to 5. A map is constructed showing the position of the fluxes of precipitating and quasitrapped particles at heights of ~250 km. (auth)

36868 ENERGY SPECTRUM OF EPITHERMAL NEUTRONS IN THE ATMOSPHERE. Abdurakhmanov, A. Kh.; Efimov, Yu. E.; Romanov, A. M.; Stepanova, E. G.; Chichikalyuk, Yu. A. (Physical-Technical Inst., Kazan). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 666-9(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 780-4(1971).

The results of experimental investigations of the spectra of epithermal neutrons in the equilibrium layers of the atmosphere are reported. The measurements were made from 1967 to 1969 at Φ = 57°N. The procedure used to calibrate the detectors and the results obtained are described. (auth)

36869 THEORY OF IONOSPHERIC SPREAD-F. Alimov, V. A.; Erukhimov, L. M.; Pyrkova, T. S. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 674-9(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 790-7(1971).

The mechanism responsible for the spread of a pulsed sounding signal as a consequence of radio-wave scattering on ionospheric electron-density inhomogeneities (measuring ~1 to 5 km) is analyzed. The characteristic relationships between the height interval of diffusivity and operating frequency in ground-based and satellite soundings of the ionosphere at various latitudes are computed from the results of the diffraction theory of spreading of pulsed signals in a randomly inhomogeneous medium and from data on the parameters of F-layer inhomogeneities, obtained by radio astronomical and satellite methods. The results of the computations agree well with corresponding experimental data. (auth)

36870 ABSORPTION IN THE LOWER NIGHTTIME IONOSPHERE AS AN INDICATION OF IONIZATION PROCESSES UNDER NORMAL AND DISTURBED CONDITIONS. I. Nestorov, G. (Inst. of Geophysics, Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 680-6(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 798-807(1971).

The seasonal and cyclic absorption patterns are found from measurements of night-time absorption at various frequencies between 1958 and 1969. The seasonal absorption pattern on long and medium waves repeats the known curve with two maxima, one in winter and the other in summer. Two frequency spectra are determined on medium waves that correspond to reflection from the nighttime E and nighttime F layers. Some physical corollaries from the experimental data are indicated. A relationship between absorption and geomagnetic activity is found for a frequency of 0.48 MHz. (auth)

36871 VARIATIONS OF THE VLF FIELD IN THE POLAR REGION. Leonov, V. I.; Filippov, K. F. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 687-90 (1971).

Translated from Geomagn. Aeron.; 11: No. 5, 808-12(1971).

The diurnal and seasonal patterns of the frequency of appearance of rapid phase variations of vlf recorded at Heiss Island are investigated. The phase variations are equivalent to a change in the effective height of the waveguide above the path over a distance of 0.8 km and over a time less than 20 sec. Strong phase shifts are compared with some geophysical observations. The correlation coefficients of amplitude variations on spaced paths are computed. (auth)

36872 ELECTRIC FIELDS IN THE IONOSPHERE DURING PULSATING AURORAS. Roldugin, V. K.; Belen'kaya, B. N.; Mal'tseva, N. F. (Polar Geophysical Inst., Kola, USSR. Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 691-4(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 813-18(1971).

A spectral analysis is performed of synchronous records of SPP of the magnetic field of Pi1 and of auroral luminosity at Sogra. The analysis of the spectra shows that electric fields that are introduced into the ionosphere by a flux of auroral particles produce variations of ionospheric currents responsible for the excitation of geomagnetic micropulsations. The magnetic field excited at the surface of the Earth by currents crossing a pulsating spot, by spreading ionospheric currents, and Hall currents is computed. (auth)

36873 ESTIMATES OF THE HEIGHTS AND CONCENTRATION OF THE ATOMIC OXYGEN LAYER IN THE UPPER ATMOSPHERE OF THE EARTH. Ivanov-Kholodnyi, G. S.; Katyushina, V. V. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 695-8(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 819-24(1971).

An approximation method is proposed for estimating the height and concentration of the atomic oxygen layer maximum. The role of various assumptions regarding the intensity of solar dissociative radiation, turbulent diffusion intensity, and the atmospheric model is examined. It is found that during the equinox the atomic oxygen concentration maximum at latitude 45° is located in the height interval 90 to 100 km and the maximum concentration in it is $\sim 10^{12}$ cm^{-3}. The results are compared with available experimental data. (auth)

36874 N AND NO VARIATIONS AT HEIGHTS OF 100 TO 250 KM. Krasnopol'skii, V. A. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 699-704(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 825-31(1971).

Differences in the processes of N and NO formation are examined. Cosmos-224 data are used to investigate the variations in the concentration of these components in the course of the day and as a function of solar activity. (auth)

36875 ELECTRODYNAMIC EFFECTS OF THE INTERACTION OF CHARGED-PARTICLE FLUXES WITH THE ATMOSPHERE. II. Osipov, N. K.; Pivovarov, V. G. (Inst. of Radio Engineering, Moscow. Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 715-20(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 845-52(1971).

The possibility is examined of the formation of an auroral current system under the combined action of two effects of the interaction of charged-particle fluxes with the atmosphere: the ionization of regions of auroral-particle injection and their polarization by the field of the space charge carried by charged particle fluxes. It is demonstrated that the combination of these effects is sufficient for the formation of the auroral current system. (auth)

36876 DYNAMICS OF THE BELT OF DR CURRENTS AND MIDDLE-LATITUDE RED ARCS. Zaitseva, S. A.; Pudovkin, M. I.; Oryakhlov, V. V.; D'yachenko, V. N. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 721-5(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 853-9(1971).

Ground-based data are used to analyze the dynamics of the belt of DR-currents in the course of a storm. The position of the DR-current is determined from magnetic data for the adopted model of the equatorial ring current and from observations of middle-latitude red arcs. It is demonstrated that the ring current appears at $L \approx 7$ at the beginning of a storm and then approaches the earth as the storm develops. (auth)

36877 AU AND AL INDICES ON INTERNATIONAL QUIET DAYS AND GEOMAGNETIC FIELD VARIATIONS AT HIGH LATITUDES. Afonina, R. G.; Fel'dshtein, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 726-30(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 860-5(1971).

The patterns of variation of the AU and AL indices on international magnetically quiet days are investigated, and it is shown that the changes in the intensity of the easterly and westerly currents with universal time at $\Phi \leq 70°$ are out of phase. The UT variation of the AU/AL ratio is interpreted as the redistribution of the current of the electrojet on the day side of the polar region, which closes in the form of evening and morning eddies. This redistribution changes significantly with the season: the current closes most intensively through the evening sector at 14 – 16h UT in summer and at 2 – 4h UT in winter. The intensity and direction of the ionospheric current in the polar region and its closing in the form of an evening and a morning eddy are not associated with the westerly auroral electrojet, but depend on the diurnal and annual orientation of the axis of the eccentric dipole with respect to the direction of the solar wind. (auth)

36878 FORM AND NATURE OF THE CHANGE OF THE ENERGY SPECTRA OF ANOMALOUS MAGNETIC AND GRAVITATIONAL FIELDS. Lugovenko, V. N.; Serkerov, S. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow. Moscow Inst. of the Oil and Gas Industry). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 734-6(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 871-4(1971).

The nature of the changes of the autocorrelation functions of anomalous magnetic and gravitational fields is analyzed as a function of the depth of sources and the distance between them. (auth)

36879 EQUIPMENT FOR INVESTIGATING ALBEDO-NEUTRON FLUXES IN NEAR-EARTH SPACE. I. Antonova, I. A.; Korol'ko, E. B.; Lazarev, V. I.; (and others) (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 744-6(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 883-7(1971).

The physical operating principles and the design of equipment for measuring the total albedo-neutron flux in near-earth space are described. The neutrons are recorded with a scintillation crystal. High neutron recording efficiency is achieved by using a polyethylene moderator. The phoswich effect is used to eliminate the charged-particle background. (auth)

36880 MAGNETO-ACOUSTIC DISTURBANCES PRODUCED BY EXPANSION OF AN IDEALLY CONDUCTING SPHERE IN A COLD PLASMA. Gorbachev, L. P.; Savchenko, Yu. N. (Moscow Engineering-Physics Inst.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 755-8(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 898-900(1971).

Magneto-acoustic disturbances arising from an arbitrary change of an ideally conducting sphere in a cold plasma are analyzed. A supposition is made that at $t = 0$, an ideally conducting sphere centered at the origin of the coordinates appears in a cold plasma in the presence of a constant external magnetic field B_0. The rate of change of the radius of the sphere R(t) satisfies the inequality $|dR/dt| < V_a$, where t is the time from the instance of appearance of the sphere and V_a is Alfvén velocity. The time dependences of the electric-field intensity and of the angular components of magnetic-field induction are presented. Also, the time dependences of the absolute magnetic-field induction and of the radial component of this induction are shown. Finally, the dependence of the energy flux of hydromagnetic disturbances on the parameter β, the ratio of the average rate of expansion of the sphere to Alfvén velocity, is given. (J.C.W.)

36881 EFFECTS OF DISTURBANCES IN THE ELECTRON DENSITY OF THE TOPSIDE IONOSPHERE ON THE NIGHT SIDE OF THE EARTH. Fatkullin, M. N.; Legen'ka, A. D.; Romanenko, A. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 758-60(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 901-3(1971).

The behavior of the topside ionosphere on the night side of the Earth on Sept. 14, 1963 during a magnetic storm was investigated. Quiet-time data of Sept. 13, 1963 were used for control purposes. Data for two passes of Alouette-1 were used to study N_mF2, the $n_e(h)$ profiles of the topside ionosphere, and the integral electron content. Results show a latitudinal distribution of N_mF2 under quiet conditions at night has two main characteristics: a middle-latitude valley for $I \approx 70$ to 72°N and an equatorial anomaly. The maxima of this anomaly occur at $I \approx \pm 20°$. The latitudinal distribution of N_T in the topside ionosphere has the same peculiarities as N_mF2 under quiet conditions. Another peculiarity of N_T variations under disturbed conditions is the disappearance of the equatorial anomaly and near the magnetic equator $\Delta N_T \approx 140\%$. A comparison of the $n_e(h)$ profiles shows that reliably identifiable positive n_e disturbances in the topside ionosphere are observed only at latitudes where $I > 42°$N and, as a rule, the effect of the disturbances is more pronounced at higher levels at high latitudes. (J.C.W.)

36882 VARIATIONS IN THE HEIGHT OF THE F_2-REGION MAXIMUM AND OF TEMPERATURE AT EQUATORIAL LATITUDES. Sire, A. Sh.; Agalakov, V. S. Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 760-3(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 904-5(1971).

Ionospheric data on h_pF2 and h'F (height of the F2-region maximum and virtual height of the F-region, respectively) from Ibadan for 1958 and 1965 were used in addition to data on the radio-noise flux at 8 cm (F), relative sunspot numbers (R), and geomagnetic A_p index for 1958 and 1965 to study variations in the F2-region maximum and of temperature at equatorial latitudes in the course of a day. An F2-region anomaly was found at equatorial latitudes, i.e., a valley in electron density in the zone of the geomagnetic equator at heights of 300 to 450 km, and great heights of the maximum during the daytime. The physical parameters of the medium do not show a seasonal behavior at these latitudes and this allows an analysis of their variations as a function of solar activity. There is a temperature equilibrium at heights of 350 to 400 km in this region. (J.C.W.)

36883 MOVEMENT AND SPREADING OF THE SPORADIC-E LAYER. Ignat'ev, Yu. A.; Krotova, Z. N. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 763-5(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 906-8(1971).

The movement and spreading of the sporadic-E layer was investigated under the effect of constant horizontal winds, starting from the instant when the source of the layer disappears, and its lifetime was estimated. An equation is presented for the spreading of inhomogeneities with a given initial ionization distribution due to diffusion and recombination in the presence of constant horizontal neutral-particle winds; the case is analyzed when the E_s forms from metallic ions of meteoric origin as a result of wind shear. Results show that, after the source of E_s disappears, the E_s layer spreads slowly in each case, when instant t = 0, t = 1800, and t = 3000 sec. In this time, the E_s can move considerably from its place of origin under the effect of horizontal winds and also rise (lower) slightly along the vertical. The results also can explain E_s observations in the absence of vertical shears in the neutral-particle wind. (J.C.W.)

36884 INTERPRETATION OF LOW-FREQUENCY IMPEDANCE MEASUREMENTS IN NEAR-EARTH PLASMA. Mikhailov, Yu. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 773-5(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 916-18(1971).

Experimental investigations of the impedance of an antenna at low frequencies in near-Earth plasma are primarily auxiliary because the value of impedance is needed in measurements of low-frequency electric fields in a plasma using an electric antenna. However, there is reason to believe the impedance measurements may become an independent method of studying the wave properties of the near-Earth plasma. Difficulty lies in performing measurements with a single probe. Under actual conditions the probe is connected with the body of the spacecraft, or symmetric probes are used for measurements. Estimates show that the mutual effect of the probes and the effect of the spacecraft body on the probes at the heights under consideration cannot be disregarded. Some previous calculations had to be supplemented by computations of the impedance of symmetric probes and also by an estimate of the effect on it of the spacecraft body. The main qualitative result of the computations was the establishment of the relationship between impedance and the angle between the magnetic field and the measuring base of the probes. The impedance curve of the symmetric probe with allowance for surface effects in the presence of a spacecraft that rotates with respect to the magnetic field differs significantly from the characteristic of a single probe. (J.C.W.)

36885 SEMIANNUAL VARIATIONS OF ATOMIC OXYGEN CONCENTRATION. Katyushina, V. V.; Ivanov-Kholodnyi, G. S. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 775-6(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 919(1971).

The ratio of atomic and molecular oxygen concentrations was investigated in the course of a year at a height of 130 km where the greatest number of mass spectrometer measurements have been made. The O/O_2 ratio, based on data, is given as a function of time of the year; a semiannual pattern is observed, with a O/O_2 maximum during the equinoxes and an amplitude that varies by a factor of approximately 3 to 5. A comparison was made of the variations of the ratio of Ar/N_2 concentrations at a height of 120 km in the course of one year from experimental data, and an unknown effect is shown for semiannual variations in the relative concentrations of O and Ar in at 120 to 130 km. The relative concentration of atomic oxygen increases from ~100 to 400 to 600 km. Its semiannual variations must therefore produce semiannual variations in the density of the upper atmosphere that increase with height. In the absence of other sources of semiannual variations, their maximum amplitude must be ~3 and occur in the region where atomic oxygen predominates, i.e., at heights of 500 to 700 km. (J.C.W.)

36886 EXCITATION MECHANISM OF NI 5199 A LINES IN THE DAY AIRGLOW. Gupta, Shashi K. (Univ. of Allahabad, India). Astrophys. Space Sci.; 13: No. 1, 203-10(Sep 1971).

Production rates of $N(^2D)$ metastable atoms in the daytime atmosphere were calculated for different possible processes, using positive ion composition and reaction rate data, available presently. Emission rates of the 5199 Å doublet of N I were calculated by separately and jointly considering the deactivation of $N(^2D)$ atoms by electrons and molecular oxygen. From a comparison of the computed results with the observational data, an attempt was made to identify the process of importance to the production and deactivation of $N(^2D)$. For further confirmation of the proposed mechanism the variation of integrated intensity of this radiation with solar activity was obtained. The calculated values may be compared with intensity data obtained in future at different levels of solar activity. (auth)

Particle Kinetics and Trapping

Refer also to abstract 36876.

36887 RESPONSE TIME OF THE MAGNETOSPHERE TO THE INTERPLANETARY ELECTRIC FIELD. Rostoker, Gordon; Lam, Hing-lan; Hume, William D. (Univ. of Alberta, Edmonton). Can. J. Phys.; 50: No. 6, 544-7(15 Mar 1972).

Data from the IMP-1 satellite are used to determine the lag time between the response of the index of geomagnetic activity AE to fluctuations in the azimuthal component of the interplanetary electric field as measured in the solar ecliptic coordinate system. The lag time is found to lie in the range 30 to 50 min. The magnitude of the lag time is related to the average energy content of the magnetosphere. (auth)

36888 MAGNETIC STORM OF FEBRUARY 11, 1969: STUDY OF THE INCOHERENT SCATTER. Alcayde, D. (CNRS, Toulouse); Testud, J.; Vasseur, G.; Waldteufel, P. J. Atmos. Terrest. Phys.; 34: No. 6, 1037-52(Jun 1972). (In French).

Incoherent-scatter observations of ion temperatures and velocities and electron and neutral densities during a magnetic storm are analyzed. The data show distinctly the existence of average storm effects, as well as long-period (>5 h) and short-period (≃2 h) variations. These effects are investigated in turn, and the interpretation of the two latter in terms of neutral gravity waves is established. (auth)

36889 MODEL OF A MAGNETOSPHERIC SUBSTORM. Lyatskii, V. B.; Mal'tsev, Yu. P. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 711-14(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 839-44(1971).

The main patterns of the active phase of a magnetospheric substorm are explained from the viewpoint of the excitation of a shock wave in the neutral sheet of the tail of the magnetosphere. The electric field that arises in the vicinity of the shock wave front because protons no longer retain their frozen-in state in rapidly moving lines of force can be responsible for the development in the ionosphere of a current system that produces a negative magnetic disturbance at the surface of the earth. (auth)

36890 FREQUENCY DRIFT OF GEOMAGNETIC PULSATIONS OF THE PDP TYPE. Kiselev, B. V.; Raspopov, O. M. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 731-3(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 866-70(1971).

The characteristics of proton motion in the equatorial plane of the magnetosphere under the effect of a homogeneous electric field and of the electric field of geomagnetic disturbances are analyzed. It is demonstrated that, in a disturbed magnetosphere, protons may drift radially toward the Earth to the west of the evening end of the auroral electrojet and that this may lead to the frequency drift of geomagnetic pulsations of the PDP type. (auth)

36891 GEOMAGNETIC EFFECTS OF DISCONTINUITIES AND MODELS OF MAGNETOSPHERE DEFORMATIONS. Mikerina, N. V.; Ivanov, K. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 776-8(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 920-1(1971).

From earlier studies, it was concluded that Mead's model of magnetospheric deformations with a free molecular flow regime gives overestimated (by a factor of as much as ~1.5 to 2) contraction field values compared with experimental values at temperature latitudes. The conclusion is supported by an analysis of the geomagnetic effect of a fast hydromagnetic shock wave (Ivanov, et al., NSA 25: 47429) and also (Siscow, et al., NSA 22: 41481) of the effects of a series of dynamic pressure jumps as observed on Pioneer 6. It was found that switching from Mead's model to hydrodynamic flow does not significantly improve the agreement between the theoretical and experimental values of disturbances on Earth. Therefore it was assumed that compression of the magnetosphere is accompanied by a substantial increase of the energy of the magnetospheric plasma that leads to a marked decrease in the growth of the field on Earth. It is mentioned that Shabanskii's two-dipole model of magnetospheric deformation naturally leads to sufficiently low and experimentally acceptable values of the compression field on Earth, and data are presented graphically. According to Shabanskii, with a simultaneous increase in dynamic pressure and decrease in static pressure an extremely small geomagnetic effect is expected on Earth. This conclusion is supported by the nature of the geomagnetic effect of the filamentary inhomogeneity on Earth, which indicates that the effect of magnetosphere deformation is practically nonexistent. (J.C.W.)

36892 ASYMMETRY OF THE FIELD OF A PARTIAL RING CURRENT. Shevnin, A. D. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 778-80(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 922-4(1971).

The magnitude of the field asymmetry is estimated by assuming, in the first approximation, that the partial ring current is an arc of a linear current of constant density flowing in the plane of the geomagnetic equator at the same distances from the Earth as the closed ring current. Computations were made of the DR field of a partial ring current along the geomagnetic equator at the surface of the Earth for distances of 4 and 7.5= R_E. The current strength was taken such that the complete linear ring current would give DR = $-100\ \gamma$ on the surface of the Earth. It was found that the magnetic field decreases most at the point located under the center of the arc with the current and least on the opposite side of the Earth. The magnitude of the field asymmetry depends on the dimension of the arc of the partial ring current and increases as the current approaches the Earth. The deviation of the field of the H component on Dec. 24, 1966, from the quiet time of Dec. 7 and 19, was examined, with allowance for currents induced in the Earth at observatories located at latitudes 20 and 40° (to exclude the effect of the equatorial electrojet); it was found that the partial ring current is centered on the night side of the magnetosphere in the longitude sector of ~180°. (J.C.W.)

Solar Wind and Cosmic Ray Interactions

Refer also to abstract 36864.

36893 SPHERICALLY SYMMETRIC OUTFLOW OF PLASMA FROM THE SUN. Alekseev, I. I.; Shabanskii, V. P.; Shister, A. R. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 651-3(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 761-4(1971).

It is demonstrated that the spherically symmetric flow of solar-wind plasma must be analyzed by taking into account the equation of motion for all velocity components. An analysis of this kind of a stationary problem within the framework of single-fluid magnetohydrodynamics leads to two independent solutions for the velocity of radial plasma motion. A comparison with experiment shows that the interplanetary field must be described in the framework of an asymmetric flow model. (auth)

36894 NONLINEAR INTERACTION OF GALACTIC COSMIC RAYS WITH INTERPLANETARY MAGNETIC FIELDS AND POSSIBLE GEOMETRY OF THE SOLAR WIND. Dorman, I. V.; Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 663-5(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 776-9(1971).

The effect of the nonlinear interaction of galactic cosmic rays with the solar wind on the structure and geometry of the "near" and "distant" solar-wind regions is investigated. It is demonstrated that transverse gradients must appear and the solar wind must be compressed by cosmic rays in the "near" region, characterized by anisotropic diffusion. The geometry of the "outer" region, where cosmic-ray diffusion must be isotropic, is determined mainly by the ratio of the energy density of cosmic rays in interstellar space to the energy density of the magnetic field of the galactic arm in the vicinity of the solar system. (auth)

36895 POSSIBLE GENERATION OF LONG-PERIOD PULSATIONS AT THE BOUNDARIES OF MAGNETOSPHERIC CONVECTIVE CURRENTS. Mal'tsev, Yu. P. (Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 781-3(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 925-6(1971).

The existence of sharp velocity discontinuities of convective currents within the magnetosphere is assumed. An attempt is made to find the possible width of a discontinuity that would produce an instability and to determine the characteristic properties of the pulsations thus generated. Properties are given for the estimated model and are typical of regular geomagnetic pulsations of the Pc5 type with periods of several minutes, but possible variations are stated. Thus, surface waves can be generated at the boundaries of convective currents within the magnetosphere under certain conditions. These waves are recorded directly on Earth in the form of geomagnetic pulsations. These pulsations have the following properties: (a) their period is close to the period of resonance oscillations of a line of force; (b) wave generation is most probable for geomagnetic shells having a large period of resonance oscillations and, consequently, these pulsations must be observed most frequently at auroral latitudes; (c) the region where the pulsations are observed is latitudinally localized; and (d) the pulsations are nearly circularly polarized. A detailed analysis of surface waves that may be responsible for long-period geomagnetic pulsations requires that allowance be made for magnetic-field inhomogeneities, the velocity field, and density. (J.C.W.)

36896 COSMIC-RAY NEUTRON SPECTROGRAPH USING RECORDING CHANNELS WITH DIFFERENT τ. Blokh, Ya. L.; Dorman, L. I.; Kaminer, N. S.; Kapustin, I. N. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow. Polar Geophysical Inst., Kola, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 749-50(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 891(1971).

Data on cosmic-ray intensity variations from neutron-monitor records have been used to study electromagnetic processes and specifically, of large-scale magnetic fields in space. To study the energy spectrum of cosmic-ray variations, which describes the mechanism of formation of these variations, intensity variations of the nucleonic component in various energy intervals must be known. A single-instrument method (a neutron monitor) is proposed here; it records the data simultaneously with several different dead times. The recorded neutrons are separated by energy, which means that the method is free of the coincidence effect and has changeable energy characteristics and a sufficiently high statistical accuracy. (J.C.W.)

36897 RELATIONSHIP BETWEEN SOLAR ACTIVITY INDICES AND COSMIC-RAY INTENSITY. Kolomeets, E. V.; Shakhova, Yu. A. (Kazakh State Univ., Alma-Ata, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 750-3(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 892-4(1971).

It is stated that the best solar activity index that describes galactic cosmic-ray modulation is the ratio of the intensities of the green (λ 5303 A) and red (λ 6374 A) coronal lines, which depends only on temperature. Since solar-wind velocity also depends on the temperature of the corona, the intensity ratio of these lines must best describe cosmic-ray modulation. Correlation coefficients of cosmic rays with the intensity of the 5303-A line, the I_{5303}/I_{6374} ratio, the sunspot number over the entire disk, and radio noise at frequencies of 600, 2800, and 9400 MHz were determined. The intensities of the 5303- and 6364-Å lines and their ratio were taken for various belts separately for the northern and southern hemispheres of the Sun. The correlation coefficient reaches its highest value in the midlatitude zone. The computations were performed for two periods, 1957–1965 and 1962–1965. The first period extends from the solar activity maximum to the minimum and the second refers to a relatively small change in solar activity. (J.C.W.)

36898 INCREASE IN THE CUTOFF RIGIDITY OF SOLAR COSMIC RAYS DURING A PCA EVENT ASSOCIATED WITH THE COMMENCEMENT OF A GEOMAGNETIC DISTURBANCE. Driatskii, V. M.; Shirochkov, A. V. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 753-5(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 895-7(1971).

The PCA event of Nov. 2–3, 1967 was examined using riometer absorption data at Mirny, Molodezhnaya, and Vostok and information on the intensity of solar protons with an energy $E_p > 10$ MeV obtained from Explorer 34. The magnetogram of Molodezhnaya shows that, in the period between 16 and 17h UT, a magnetic disturbance commenced in the H component that then changed to a magnetic storm. It can be assumed that the anomalous decrease of absorption at Molodezhnaya was produced by a sudden increase in the cutoff rigidity of solar cosmic rays, associated with the initial phase of the magnetic disturbance. This effect is the result of a change in the conditions of penetration of low-energy solar protons into the Earth's magnetosphere. The effect that caused the anomalous increase in cutoff rigidity is discussed. The tail of the magnetosphere apparently contracted between the instant of the commencement of the geomagnetic disturbance and the appearance of the ring current, and the magnetic-field intensity in it decreased to 15 to 20 γ, judging from the magnitude of the decrease of absorption on the riometer. The riometers at Mirny and Vostok do not show any effect from the increase in cutoff rigidity, since these stations are located in the region of open lines of force and the magnetic disturbance could not have changed the conditions of penetration of solar protons. Here riometric absorption was determined only by solar cosmic-ray intensity. (J.C.W.)

36899 EFFECTIVENESS OF SOLAR FLARES. Pudovkin, M. I.; Chertkov, A. D. (Leningrad State Univ.). Dokl. Akad. Nauk SSSR; 201: No. 1, 75-7(1 Nov 1971). (In Russian).

The effectiveness of solar flares may be related to the orientation of the magnetic field in the region of the flares. Thus, a number of magnetic storms were studied in relation to the configuration of the magnetic field on the Sun in 1968–1969. An analysis of 22 flares and their geomagnetic effects showed that in all cases when the magnetic field in the neighborhood of the flare was directed southwards, the flares evoked a greater magnetic activity on the Earth. When this field was directed toward the north, the flares either were not accompanied by noticeable geomagnetic effects, or cancelled the previous disturbance. (K.S.W.)

PHYSICS (ATOMIC AND MOLECULAR)

Atomic, Electron, Ion, and Molecular Beams and Their Reactions

Refer also to abstracts 36303, 37730, 37731, and 37759.

36900 (ORO–3557-13) PROTON SPUTTERING. Sixth Annual Progress Report, June 1, 1971–February 28, 1972. Finfgeld, Charles R. (Roanoke Coll., Salem, Va. Dept. of Physics). Contract AT(40-1)-3557. 8p. Dep. NTIS.

The sputtering yields for H^+ and D^+ on both Ta and Ca as a function of energy over the range 500 eV to 8 keV are reported briefly. The yields are lower than those reported earlier for Au and Ag and less dependent on energy. The yield maxima occur at about 4 keV for both H^+ and D^+ on Co but are not below 8 keV for both ions on Ta. (A.G.W.)

36901 APPARATUS USING ULTRASHARP DIAMOND EDGE FOR ULTRATHIN SECTIONING. Villalobos,Humberto Fernandez-Moran. U. S. Patent 3,646,841. 7 Mar 1972. Filed 2 Jun 1969.

An ultrasharp diamond edge used for molecular and submolecular sectioning at ultralow temperature and used as a high-intensity point source for the emission of electrons, ions and neutrons is described. (auth)

36902 NEW METHOD FOR THE MEASUREMENT OF ELECTRON YIELD FROM ION BOMBARDMENT. Stein, J. D.; White, F. A. (Rensselaer Polytechnic Inst., Troy, N. Y.). J. Appl. Phys.; 43: No. 6, 2617-20(Jun 1972).

A new technique is described for measuring directly the statistical distribution of electrons produced by single positive ions striking a surface. This method complements present techniques and permits the determination of the electron emission coefficient γ due to ion impact on semiconductors or insulators. Previous measurements of this type have been difficult or impossible owing to charge buildup on the target. In this new experimental approach, a beam of mass- and energy-resolved positive ions is focused on the surface being studied. Electrons ejected by individual ions are then accelerated through from 10 to 30 keV and focused into a silicon surface-barrier detector. The magnitude of the detector output pulse produced corresponds to the number of electrons striking the detector simultaneously thus giving the electron yield. Preliminary results for the secondary electron yield coefficient γ are reported for aluminum oxide and titanium oxide surfaces bombarded by cesium, barium, lithium, and strontium ions having incident kinetic energies in the range of 10 to 40 keV. (auth)

36903 CATHODE DARK-SPACE MEASUREMENTS AND DEPOSITION RATES OF TANTALUM IN A SPUTTERING SYSTEM. Westwood, W. D.; Boynton, R. (Bell-Northern Research, Ottawa). J. Appl. Phys.; 43: No. 6, 2691-7(Jun 1972).

Measurements of the cathode dark-space distance were made, both visually and electrically, for an argon discharge in a dc diode sputtering system fitted with a tantalum cathode. The values are fitted by Aston's dark-space equation and are used to calculate the dependence of sputtering rates on discharge conditions. These calculated values are in good agreement with the deposition rates measured for films deposited on glass substrates. The variation of discharge voltage with current does not fit Aston's cathode-fall equation, which must be modified slightly. A change of slope observed in the current–voltage relationship may be due to heating of the system by the discharge. The modified Aston's equation also fitted the current–voltage curve for a platinum cathode and the same change of slope was observed. (auth)

36904 EMISSION OF CHARACTERISTIC L AND K RADIATION FROM THICK TUNGSTEN TARGETS. Storm, Ellery (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys.; 43: No. 6, 2790-6(Jun 1972).

A method is proposed for calculating L and K photon emission from thick tungsten targets bombarded by electrons accelerated by potentials of 12 to 300 kV. Electron energy losses, electron backscatter losses, and photon attenuation in the target are included. Agreement with measured K emission is obtained using the Arthurs–Moiseiwitsch ionization cross sections and an expression of the form $CZ\ [(E_0 - k)\ 1 - \exp(-3k/E_K)]/[(k/E_0)^{1/2}\ 1 - \exp(-E_0/E_K)]$ to describe the bremsstrahlung energy distribution. Satisfactory agreement with L-emission measurements is obtained using the Mott–Massey cross-section formula with constants $B_{L_i} = 4\ E_{L_i}$, $b_{L_I} = 0.25 \times 1.6$, $b_{L_{II}} = 0.25 \times 2.75$, and $b_{L_{III}} = 0.25 \times 4.2$. Indirect radiation contributes 54 to 82% of the total K emission and 5 to 8% of the total L emission. The Webster–Clark empirical relation $I_i = C_i(U_0 - 1)^{n_i}$ agrees with calculation for $U_0 < 3$, with $C_K = 5.1 \times 10^{11}$ photon/s mA sr, $n_K = 1.67$, $C_L = 2.6 \times 10^{11}$ photon/s mA sr, and $n_L = 1.5$. (auth)

36905 ENERGY SPECTRUM OF SLOW MONOENERGETIC ELECTRONS REFLECTED BY STAINLESS STEEL. Adnot, A.; Ballu, Y.; Carette, J. D. (Univ. Laval, Quebec). J. Appl. Phys.; 43: No. 6, 2796-9(Jun 1972).

The energy spectra of monoenergetic electrons reflected from a surface of stainless steel have been measured. In the spectra one may detect two types of energy losses: (i) weak and multiple losses, which may be associated with the weakly adsorbed phase of the residual gas of the vacuum system; (ii) strong and discrete losses caused by chemisorbed molecules on the surface. The values of these discrete energy losses are compatible with a model of molecular structure of the chemisorbed species on the surface. (auth)

36906 METHOD OF OBTAINING PARALLEL FOCUSED ION MICROBEAMS. APPLICATION TO THE MASS PRODUCTION OF ELECTRICAL CIRCUITS BY ION IMPLANTATION. Glotin, Philippe; Guernet, Georges; Lacour, Jacques (to Commissariat a l'Energie Atomique). French Patent 2,080,511. 19 Nov 1971. Filed 20 Jan 1970. (In French).

A procedure for obtaining practically identical parallel microbeams, which are focused and composed of single-energy ions of a single isotope of a particular element, is described. Ions emitted from an ion source are accelerated and focused; an isotopic separation is effected on the accelerated ions in order to retain only ions of a single isotope of the particular element. The ion beam emitted from the isotopic separator is then transformed into a parallel beam of large cross section. This large-cross-section parallel beam is then divided into small-cross-section microbeams, which are focused to reduce their impact surface on the sample. Application of the beams to ion implantation is discussed. (TSS) (France)

36907 INTERACTION OF HYDROGEN BEAMS WITH METAL SURFACES. Chappell, R.; Hayward, D. O. (Imperial Coll. of Science and Tech., London). J. Vac. Sci. Technol.; 9: No. 3, 1052-5(May-Jun 1972).

The angular distributions of hydrogen scattered from the surfaces of polycrystalline platinum and molybdenum, and from the (100), (111), and (110) faces of molybdenum single crystals were measured. With platinum both a sharp specular peak and a subspecular peak were observed, and these diminish in intensity as the surface becomes covered with hydrogen. The second peak is thought to result from diffraction. On a clean polycrystalline molybdenum surface, 68% of the incident beam is chemisorbed, 24% is diffusely reflected, and 8% is specularly reflected. It is found that the diffuse and specular components come from different crystal faces, the (100) and (111) faces giving predominantly diffuse scattering and the (110) face specular reflection. (auth)

Atomic and Molecular Properties

Refer also to abstracts 36944, 36945, 37243, 37726, 37794, and 37800.

36908 GEOMETRIC-MEAN WAVE FUNCTION FOR HeH^{2+}. Lam, C. S.; Varshni, Y. P. (Univ. of Ottawa). Can. J. Phys.; 50: No. 7, 666-7(1 Apr 1972).

A geometric-mean type of variation function was examined for the $1s\sigma$ state of HeH^{2+} and found to give very good results for the energy. (auth)

36909 DELVES PRINCIPLE APPLIED TO HELIUM USING A NUMERICAL EXCITED HARTREE BASIS. Sokoloff, J. (York Univ., Toronto). Can. J. Phys.; 50: No. 7, 703-7(1 Apr 1972).

Expectation values for $r_1^n + r_2^n$, n = 2, 1, −1, −2, and $1/r_{12}$ for the ^1S state of helium were calculated using numerical Hartree orbitals. These were then modified by use of the Delves principle, approximating the auxiliary vector of the Delves formalism with a nine-term basis formed from the numerical excited orbitals of the ground-state Hartree operator. The modified expectations were then compared with the essentially exact calculations of Pekeris. Results are mixed: excellent for n = 1, 2, modest for $1/r_{12}$, and poor for n = −1, −2. It is conjectured that the latter results are due to a deficiency of s orbitals in the basis used engendering a poor approximation to the auxiliary vector for these operators. (auth)

36910 ACCURATE NUMERICAL HARTREE–FOCK SELF-CONSISTENT-FIELD WAVE FUNCTIONS FOR La^+, Tm^+, AND Yb^+. Saxena, K. M. S. (Univ. of Alberta, Edmonton). Can. J. Phys.; 50: No. 7, 708-9(1 Apr 1972).

Accurate numerical Hartree–Fock (HF) self-consistent-field (SCF) wave functions were obtained for $La^+(4f^1 6s)^3F$ and ^1F, $Tm^+(4f^{13}6s)^3F$ and ^1F, and $Yb(4f^{14}6s)^2S$ rare-earth ions. In general, the total energy values have an accuracy of seven figures, the virial theorem is satisfied to seven significant digits, and the radial wave functions are self-consistent and without tail oscillations to three decimals. Several Hartree–Fock parameters are also evaluated with these functions. (auth)

36911 ELECTRONIC STRUCTURE OF THE GROUND STATE OF THE HeH^+ MOLECULE. Yamada, Toshiko (Ochanomizu Univ., Tokyo); Sato, Hiroshi; Ishiguro, Eiichi; Takezawa, Terashi J. Phys. Soc. Jap.; 32: No. 6, 1595-1604(Jun 1972).

The total electronic energy of HeH^+ is calculated using wave functions in which the "in–out correlation" is included by using two different 1s Slater-type atomic orbitals of He. The conclusion is that the effect of the in–out correlation of electrons in the vicinity of the He nucleus is considerable in HeH^+, though it is somewhat smaller than that in the He atom. Among the four wave functions employed here, the simplest one can give a qualitative explanation of the electronic structure of this system. The results computed with the simplest wave function are $E(R_e) = -2.935026999$ au, $R_e = 1.46663$ au, $\omega_e = 3.1 \times 10^3$ cm^{-1}, and $D_e = 1.62$ eV. The best values of $E(R_e)$ and R_e, calculated by use of the most flexible wave function, amount to -2.93819775 au and 1.4648 au, respectively. (auth)

36912 PHOTOIONIZATION AND AUTOIONIZATION OF H_2. Shaw, Gilbert B.; Berry, R. Stephen (Univ. of Chicago). J. Chem. Phys.; 56: No. 12, 5808-17(15 Jun 1972).

The cross sections are calculated for direct photoionization and photoexcited autoionization of H_2 for light in the region 600 to 800 Å. Angular distributions of directly produced photoelectrons, lifetimes for vibrationally induced autoionization, some spectral assignments, and relative intensities of photoelectrons of various energies (from autoionizing states) are also given. The method by which the Rydberg and continuum-state wave functions are derived is similar to the correlated pseudopotential method of Tully. The results indicate that correlation has only a small effect on the differential and total cross sections for photoionization. Agreement of theoretical and experimental lifetimes for autoionization is improved by the inclusion of correlation in the wave function. Critical tests of the calculations could be made by experimental study of the photoelectron spectra produced when H_2 is excited to certain specific autoionizing states; for these states, the theory predicts anomalously efficient autoionization associated with transfer of two vibrational quanta into electronic excitation. (auth)

36913 ABSORPTION SPECTRUM OF HD IN THE VACUUM-UV REGION: RYDBERG STATES AND IONIZATION ENERGY. Takezawa, S.; Tanaka, Y. (Air Force Cambridge Research Labs., Bedford, Mass.). J. Chem. Phys.; 56: No. 12, 6125-30 (15 Jun 1972).

The absorption spectrum of the HD molecule was investigated in the 950- to 600-Å region with a 6.65-m normal-incidence vacuum spectrograph in the second order using the helium continuum as a light source. In the spectrum of cooled HD, seven Rydberg series are identified. Four consist of the Q(1) lines in the $np\pi \leftarrow X$ transitions and converging to the v = 0, 1, 2, and 3 levels of the HD^+ ground state. The other three are identified as the R(0) series of the $np\sigma \leftarrow X$ transitions, converging to the v = 0 and 1 levels, and the R(0) series of the $np\pi \leftarrow X$ transitions converging to the v = 1 level of the HD^+ ground state. The lowest ionization energy (v = 0, N = 0) of this molecule, obtained from the Q(1) series, is 124 569.5 ± 0.6 cm^{-1}. Eight additional Rydberg series, observed near their series limits and identified as either R(0) or R(1) series, are also reported. (auth)

36914 SURFACE AND VACUUM PHYSICS INDEX. VOLUME 7, NO. 3, 1972. Bibliography, Author Index, Subject Index in Alphabetical Order, Cumulative Subject Index in Logical Order. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 52p.

This listing contains 151 references on various aspects of surface and vacuum physics. (M.O.W.)

36915 THEORETICAL INVESTIGATION OF THE ENERGY SPECTRA OF RARE EARTH ELEMENTS HAVING ELECTRONIC CONFIGURATIONS $4f^2 6s$ AND $4f^3 6s$. Vizbaraite, Ya. I.; Kychkin, I. S.; Rudzikas, Z. B. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 11: No. 6, 983-95(1971). (In Russian).

The energy spectra of the configurations $4f^2 6s$ of Pr III, Nd IV, and Pm V and $4f^3 6s$ of Nd III, Pm IV, and Sm V were studied. The effect of spin–other-orbit, spin–spin, and orbit–orbit interactions was investigated. The values of energy levels and functions were obtained by diagonalizing the energy matrix computed with the help of Hartree–Fock radial orbitals. JJ- and LS-coupling schemes were used. The theoretical results are compared with experimental data. (auth)

Positronium, Muonium, and Mesic Atoms and Molecules

Refer also to abstracts 37564 and 37770.

36916 (JINR–P14-6202) NEGATIVE MUON DEPOLARIZATION IN AQUEOUS SOLUTIONS. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

Negative-muon depolarization was measured in various aqueous solutions. It is shown that experimental data do not contradict the available data on radical behavior in aqueous solutions. The value of the residual polarization in aqueous solution of hydrogen peroxide increases by 1.8 times as compared with the residual polarization in pure water, which is interpreted as a result of chemical interaction of a mesic atom with the hydrogen peroxide molecules leading to diamagnetic-compound production. Measurements were also made on solutions of NH_4OH, NH_4Cl, N_2H_4, KOH, and HCl. (auth)

36917 (JINR–P14-6203) NEGATIVE MUON DEPOLARIZATION IN WATER AND AQUEOUS SOLUTIONS OF HYDROGEN PEROXIDE IN LONGITUDINAL AND TRANSVERSE MAGNETIC FIELDS. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

Negative-muon depolarization in water and aqueous solutions of hydrogen peroxide was measured at various values of longitudinal (from 200 to 1265 G) and transverse (from 24 to 200 G) magnetic fields. The depolarization degree is shown to be independent of the magnetic field value. In the framework of the depolarization model, taking account of mesic-atom chemical reactions, the result obtained shows that the mesic atom enters the chemical reaction in $t \cong 10^{-12}$s at T = 300°K, and paramagnetic products of these reactions, which contain mesic atoms, enter the reactions in $t_1 \geq 10^{-7}$s. (auth)

36918 (JINR–P14-6204) TEMPERATURE AND CONCENTRATION DEPENDENCE OF DEPOLARIZATION OF NEGATIVE MUONS IN AQUEOUS SOLUTION OF HYDROGEN PEROXIDE. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

Temperature and concentration dependences of the depolarization degree of negative muons in aqueous solutions of hydrogen peroxide were measured. Processing of the experimental data according to a model that takes into account the chemical interaction of a mesic atom with the medium allows one to obtain the rate constant value for the reaction of a mesic atom with hydrogen peroxide molecules with diamagnetic compound production. This constant of 5.10^{-10} s^{-1} cm^3 coincides with constants for reactions between free radicals of H and OH in water. (auth)

36919 (JINR–P14-6205) DEPENDENCE OF THE NEGATIVE MUON DEPOLARIZATION ON THE MOLECULAR WEIGHT AND TEMPERATURE IN ORGANIC COMPOUNDS. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The negative-muon atomic capture in the row of aliphatic alcohols and the dependence of the residual muon polarization on the molecular weight of alcohols are studied. The temperature dependences of depolarization in benzene and styrene are obtained. The results on depolarization are interpreted on the basis of concepts about chemical interactions of mesic atoms in organic compounds. (auth)

36920 (JINR–P14-6206) NEGATIVE MUON DEPOLARIZATION IN ORGANIC MONOMERS AND POLYMERS. Dzhuraev, A. A.; Evseev, V. S.; Kholodov, N. I.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that in the transition from monomer to polymer the residual polarization value of negative muons decreases by 1.4 times when the polymer chain does not contain binary coupling. In the presence of binary coupling (polyisoprene) the polarization is the same as in the monomer. These experimental data are interpreted on the basis of a model that takes into account the chemical reactions of mesic atoms. (auth)

36921 ENERGY SHIFTS AND WIDTHS OF K$^-$-MESIC ATOM LEVELS. Rook, J. R. (Nuclear Physics Lab., Oxford); Wycech, S. Phys. Lett.; 39B: No. 4, 469-70(15 May 1972).

The observed energy shifts and widths of K$^-$-mesic atom levels are compared with those calculated using a K$^-$-nucleus potential obtained from the K$^-$–nucleon interaction. Agreement is obtained for the shifts, but the calculated widths are about 20% too large. (auth)

36922 RELATIVE CAPTURE RATES FOR STOPPING π^-, K$^-$, Σ^- IN A NEON–HYDROGEN MIXTURE. Jhaveri, Minal R. Knoxville, Tenn.; Univ. of Tennessee (1971). 58p. University Microfilms Order No. 72-15,531.

Thesis.

The relative hydrogen capture rates for stopping π^-, K$^-$, and Σ^- were measured in a 24 mole % mixture of neon in hydrogen. These rates, 13 ± 5%, 26 ± 3%, and 42 ± 6% for π^-, K$^-$, and Σ^-, respectively, suggest that a large fraction of pions and to a lesser extent kaons undergo transfer from hydrogen to neon prior to their nuclear destruction. The general systematics of the interactions of slow π^- with neon were also studied. In particular the ratio of capture by proton–neutron pairs to that of proton–proton pairs was found to be 5.1 ± 2. (Diss. Abstr. Int., B)

36923 WEAKLY BOUND SURFACE STATES OF A POSITRONIUM ATOM. Gol'danskii, V. I.; Mokrushin, A. D.; Prokop'ev, E. P. (Inst. of Chemical Physics, Moscow). Sov. Phys.-Solid State (Engl. Transl.): 13: No. 11, 286-9(May 1972).

Translated from Fiz. Tverd. Tela; 13: No. 11, 3194-8(Nov 1971).

The surface states of a positronium atom weakly bound to the surface of a solid are analyzed. These states represent physical adsorption and a "weak" chemisorption of the positronium atom on the surface. The annihilation characteristics of a positronium atom bound with the surface are analyzed. An experimental confirmation of the existence of adsorbed positronium is very important for learning the nature of the surface states of light particles with a mass of the order of the electron mass. (auth)

Collision Phenomena

36924 (ORNL–4720, pp 56-68) ELECTRON AND ION COLLISION PHYSICS. Compton, R. N.; Anderson, V. E.; Carter, Ada; (and others) (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

ACETALDEHYDE—electron reactions up to 11 eV with, SF$_6$-scavenger studies of excitation and negative-ion formation in, (E), p. 60-2
ACETONE—electron reactions up to 11 eV with, SF$_6$-scavenger studies of excitation and negative-ion formation in, (E), p. 60-2
BORON CHLORIDES—electron reactions at thermal energies with, electron attachment and negative-ion formation in, p. 62-3
BORON FLUORIDES—electron reactions at thermal energies with, electron attachment and negative-ion formation in, p. 62-3
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CESIUM—reactions with nitrogen oxides and oxygen molecules at low energies, cross sections for charge exchange with formation of negative molecular ions in, p. 63-7
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—drift velocity in oxygen, (E), p. 57-60
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—reactions with carbonyls up to 2.5 eV, SF$_6$-scavenger study of negative-ion formation in, p. 60-2
—reactions with boron chlorides and boron fluorides at thermal energies, electron attachment and negative-ion formation in, (E), p. 62-3
HELIUM—electron reactions up to 500 eV with, integral cross sections for production of slow electrons and for total ionization in, (E), p. 56-7
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NITROGEN OXIDES N$_2$O—cesium-atom reactions at low energies with, cross sections for charge exchange with formation of N$_2$O$^-$ in, p. 63-7
—electron affinity of, p. 63-7
OXYGEN—electron reactions at thermal energies with molecular, time-of-flight measurements of electron attachment and momentum transfer in, p. 57-60
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—electron affinity of molecular, p. 63-7 (A.G.W.)

36925 (ORNL–4720, pp 69-77) ATOMIC AND MOLECULAR RADIATION PHYSICS. Christophorou, L. G.; Anderson, V. E.; Birks, J. B.; (and others) (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

BENZANTHRACENE—electron reactions below 1 eV with, cross sections for electron attachment in, p. 71-2
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BENZOPYRENE—fluorescence of, temperature dependence of, p. 76-7
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ELECTRONS—reactions with oxygen molecules at 4 to 10 eV, cross sections for dissociative electron attachment in, p. 69-71
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1,4-NAPHTHOQUINONE—electron reactions below 1 eV with, cross sections for electron attachment in, p. 71-2
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OXYGEN—electron reactions at 4 to 10 eV with molecular, cross sections for dissociative electron attachement in, p. 69-71 (A.G.W.)

36926 LOW-ENERGY CROSS SECTIONS FOR TRANSITIONS BETWEEN HIGHLY EXCITED STATES OF ATOMS. Percival, I. C. (Univ. of Colorado, Boulder); Seaton, M. J. Astrophys. Lett.; 11: No. 1, 31-3(May 1972).

Electron-impact cross sections for transitions between highly excited states are required for the interpretation of radio recombination line observations. It is shown that the conditions required for the validity of binary encounter theory are not satisfied at the low energies that occur in regions of neutral hydrogen. Quantal impact parameter theory is used to obtain an approximate upper bound on the low-energy cross sections for n → n ± 1 transitions, and hence to show that binary encounter theory gives cross sections that are much too large. (auth)

36927 GLORIES IN INELASTIC COLLISIONS: NON-MONOTONIC TEMPERATURE DEPENDENCE OF COLLISION RATES. Levine, R. D.; Johnson, B. R. (Ohio State Univ., Columbus). Chem. Phys. Lett.; 14: No. 1, 132-6(1 May 1972).

It is suggested that nonmonotonic temperature dependence of state-to-state collision rates may result from the occurrences of glories in the velocity dependence of the inelastic cross section. As in the elastic case, these are due to the existence of a minimum (i.e., a well) in the intermolecular potential. (auth)

36928 ANGULAR SCATTERING OF SUPERTHERMAL K BY I_2. Duchart, B. S.; Fluendy, M. A. D.; Lawley, K. P. (Univ. of Edinburgh). Chem. Phys. Lett.; 14: No. 1, 129-31(1 May 1972).

The small-angle scattering of 100-eV potassium atoms from a thermal cross beam of iodine molecules was measured. There is considerable structure, which is interpreted as coming from the Coulomb potential. Some contribution from the upper diabatic state is also probably needed and there is evidence of attenuation of the elastic scattering beyond $\approx 0.9°$. (auth)

36929 ROTATIONAL TRANSITIONS IN THE HD MOLECULE IN LOW-ENERGY HD–He COLLISIONS. Itikawa, Yukikazu; Takayanagi, Kazuo (Tokyo Univ.). J. Phys. Soc. Jap.; 32: No. 6, 1605-11(Jun 1972).

The close-coupling method was applied to the rotational transitions in the low-energy HD–He collisions. The interaction potential for the system was derived from the theoretical potential for the H_2–He system by shifting the center of mass of the molecule. The rotational relaxation time was calculated in the temperature range from 10 to 50°K and compared with the recent measurement by Prangsma, et al. A good agreement was obtained between theory and experiment. (auth)

36930 DISSOCIATION OF DIATOMIC MOLECULES INTO IONS BY IMPACT OF FAST IONS AND ATOMS. Gusev, V. A.; Oksyuk, A. A.; Fogel, Ya. M. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1284-90(Apr 1972). (In Russian).

The mass-spectrometer technique is employed for measuring the relative effective cross sections for formation of slow atomic negative ions produced in collisions between fast ions of hydrogen, helium, neon, argon, and krypton (3 to 50 keV energy) and O_2, CO, and NO molecules. The difference between the functions $\sigma^{+}_{B^-}(\nu)$ and $\sigma^{0}_{B^-}(\nu)$ is ascribed to the contribution to the measured cross section of processes involving dissociative electron capture by the target molecules. Some considerations regarding the mechanism of diatomic molecule dissociation into positive and negative ions are presented. (auth)

36931 CALCULATION OF THE PARTIAL PHASES OF ELECTRON SCATTERING BY ATOMS FOR VARIOUS APPROXIMATIONS. Vinogradov, V. S.; Rambidi, N. G. (Inst. of High Temperatures, Moscow). Zh. Strukt. Khim.; 12: No. 6, 947-51(Nov-Dec 1971). (In Russian).

Numerical methods of calculating partial phases in various approximations of scattering theory are described. Numerical calculations of precise partial phases of scattering were accomplished by a phase function method. Some advantages of this method in contrast to other methods used by other workers are discussed. Precise partial phases were calculated for electron scattering by an atom of uranium, and certain values were compared to those for bromine. (K.S.W.)

36932 CORRECTIONS TO VIBRATIONAL TRANSITION PROBABILITIES CALCULATED FROM A THREE-DIMENSIONAL MODEL. Stallcop, James R. (Ames Research Center, Moffett Field, Calif.). J. Chem. Phys.; 56: No. 9, 4505-12(1 May 1972).

Corrections to the collision-induced vibration transition probability calculated by Hansen and Pearson from a three-dimensional semiclassical model are examined. These corrections come from the retention of higher-order terms in the expansion of the interaction potential and the use of the actual value of the deflection angle in the calculation of the transition probability. It is found that the contribution to the transition cross section from previously neglected potential terms can be significant for short-range potentials and for the large relative collision velocities encountered at high temperatures. The correction to the transition cross section obtained from the use of actual deflection angles will not be appreciable unless the change in the rotational quantum number is large. (auth)

36933 EXCITATION OF Na D-LINE RADIATION IN COLLISIONS OF SODIUM ATOMS WITH INTERNALLY EXCITED H_2, D_2, AND N_2. Krause, H. F.; Fricke, J.; Fite, W. L. (Univ. of Pittsburgh). J. Chem. Phys.; 56: No. 9, 4593-4605(1 May 1972).

Excitation of D-line radiation in collisions of Na atoms with vibrationally excited N_2, H_2, and D_2 was studied in two modulated crossed-beam experiments. In both experiments, the vibrational excitation of the molecules was provided by heating the molecular-beam source to temperatures in the range of 2000 to 3000°K, which was assumed to give populations according to the Boltzmann expression. In the first experiment, a total rate coefficient was measured as a function of molecular-beam temperature, with absolute calibration of the photon detector being made using the blackbody radiation from the heated molecular-beam source. Since heating affects both the internal energy and the collisional kinetic energy, the first experiment could not determine the relative contributions of internal energy transfer vs collisional excitation. The second experiment achieved partial separation of internal vs kinetic energy transfer effects by using a velocity-selected molecular beam. Using two simple models for the kinetic-energy dependence of the transfer cross section for a given change in vibrational quantum number, the data from both experiments were used to determine parameters in the models. Evidently the most probable situation is that most of the Na excitation energy comes from internal vibrational energy, with the remainder coming from kinetic energy. The consequences of the detailed results with respect to the excitation of sodium radiation in auroras are discussed. (auth)

36934 EXCITATION OF THE WERNER BANDS OF H_2 BY ELECTRON IMPACT. Stone, E. J.; Zipf, E. C. (Univ. of Pittsburgh). J. Chem. Phys.; 56: No. 9, 4646-50(1 May 1972).

Absolute cross sections for the excitation of the Werner band system $H_2(C\ ^1\Pi_u \rightarrow X\ ^1\Sigma_g^+)$ were measured from threshold to 300 eV for electron impact on H_2. The bands were observed in emission in the wavelength region 1100 to 1250 Å. The measured cross sections were compared with published transition probabilities, leading to the conclusion that the Werner bands are suitable as the basis for a relative spectral response calibration only when the bands are observed under sufficiently high resolution (fwhm ~0.4 Å). The effect of the perturbation between the $C\ ^1\Pi_u$ and $B\ ^1\Sigma_g^+$ states of the hydrogen molecule was clearly observed in anomalies in the rotational intensity distribution in bands of the $(3, \nu'')$ progression. (auth)

36935 FORMATION OF SODIUM IONS BY CHARGE TRANSFER. Rutherford, J. A.; Mathis, R. F.; Turner, B. R.; Vroom, D. A. (Gulf Radiation Tech., San Diego, Calif.). J. Chem. Phys.; 56: No. 9, 4654-8(1 May 1972).

Cross sections have been measured in the energy range 1 to 500 eV for the charge transfer of several ions with neutral sodium. The ions studied are O^+, N^+, N_2^+, NO^+, O_2^+, H_2O^+, H_3O^+, N_2O^+, and Na^+. The magnitude of these cross sections can be related to the availability of reaction paths that have a small internal energy defect. The smaller the energy defect the larger the cross section. Where possible the measured cross sections were extrapolated to thermal energy. Comparison is made with other experiments. (auth)

36936 MECHANISM OF CHARGE TRANSFER REACTIONS: REACTIONS OF RARE GAS IONS WITH THE TRANS-, CIS-, AND 1,1-DIFLUOROETHYLENE GEOMETRIC ISOMERS. Bowers, M. T.; Laudenslager, J. B. (Univ. of California, Santa Barbara). J. Chem. Phys.; 56: No. 9, 4711-2(1 May 1972).

Rate constants are reported for charge transfer from various rare gas ions to the three geometric isomers of difluoroethylene, which have essentially the same polarizability and ionization potential but considerably different dipole moments. It is found that (1) all of the trans rate constants are substantially larger than predicted by the charge-induced dipole theory, (2) the rate constants exhibit a $\mu^{1/2}$ dependence, (3) there is no apparent dependence on energy defect, and (4) the rate constants increase with increasing dipole moment but the increase is substantially less than that expected for a locked dipole. The large rate constants and lack of dependence on energy defect imply a symmetric type charge exchange process is occurring at relatively long range. (A.G.W.)

36937 ABSOLUTE TOTAL SCATTERING CROSS SECTIONS OF ^{7}Li–Ar. Ury, G. B.; Wharton, L. (Univ. of Chicago). J. Chem. Phys.; 56: No. 12, 5832-7(15 Jun 1972).

The Li–Ar absolute total scattering cross section was measured to an accuracy of 1 to 2% over the relative velocity range 1 to 4×10^5 cm/s, corresponding to relative energies of 0.03 to 0.5 eV. The absolute cross section determines the radial scale of the interatomic potential, by reference to the average distance between target molecules. The present study is intended as an exemplary system investigation of inferences that can be drawn from more accurate absolute total cross sections, since currently it is believed that this class of total cross section is known to an absolute accuracy of 5 to 10% [R. B. Bernstein and J. T. Muckerman, Advan. Chem. Phys., 12: 414(1967)]. The primary finding is the value of the interatomic potential with an accuracy of about 5% over a span of the relatively large interatomic distances 6 to 8 Å. At 7 Å the Li–Ar potential is -1.97×10^{-15} erg ±5%. In this region half of the error arises from the systematic error in the cross section and half from the ambiguity about the proper potential model to apply. The results should be useful for critically testing future model potential calculations and, in conjunction with differential scattering and other data, for giving a more exact and complete understanding of the potential. An apparatus was used that had been previously applied to molecule–atom scattering, where angular resolution corrections were negligible and where absolute pressures were measured with a McLeod gauge modified to physically eliminate trap pumping error. A deconvolution procedure that took into account the effects of target motion upon the glory structure of the total cross section was applied to the data. An economical method for applying nonlinear least squares fitting of model interatomic potentials is described and is applied to the data. (auth)

36938 ELECTRON-IMPACT CROSS SECTIONS FOR ARGON. **Peterson, L. R.; Allen, J. E. Jr.** **(Univ. of Florida, Gainesville). J. Chem. Phys.; 56: No. 12, 6068-76(15 Jun 1972).**

A reasonably complete set of phenomenological discrete and ionization cross sections for argon is given using combinations of data and theoretically meaningful extrapolations of the generalized oscillator strengths. After including estimates of inner-shell cross sections, the degradation of electrons in Ar is considered. Calculations of the final populations for each excited state are given as a function of incident energy. When these results are applied to ionization, values near 29 eV are obtained for the electron volts per ion pair. Inner shells in this work appear to contribute by adding on the order of 5% to the loss function at energies above a kilovolt. (auth)

36939 EFFECT OF RESONANCE ON VIBRATIONAL DISTRIBUTIONS IN CHARGE-TRANSFER REACTIONS. **Tomcho, Linda; Haugh, Michael J. (Temple Univ., Philadelphia). J. Chem. Phys.; 56: No. 12, 6089-97(15 Jun 1972).**

The emission from the A $^2\Sigma^+ \rightarrow$ X $^2\Pi_i$ transition in HBr^+ and HCl^+ was used to monitor the vibrational distribution produced in these ions by charge transfer between the neutral molecules and Ar^+ and Kr^+ ions over the energy range from 5000 to 100 eV. In all cases the vibrational distribution at high ion velocities approached that for a Franck–Condon excitation. The vibrational distribution from the (Ar^+, HCl) and (Kr^+, HBr) reaction showed appreciable change with ion velocity. The vibrational distributions were compared with distributions that were calculated using the Rapp and Francis theory of near-resonant charge transfer, modified to take vibrational overlap into account. The (Kr^+, HBr) reaction showed quantitative agreement with calculations for the variation of vibrational distribution with ion velocity but the predictions for the (Ar^+, HCl) reaction showed only semiquantitative agreement. A large change was predicted for the (Ar^+, HBr) reaction but no change was observed. A summary is made of available data on vibrational distributions resulting from near-resonant and nonresonant charge exchange and some mechanisms are discussed. (auth)

36940 ELECTRON-IMPACT RELATIVE IONIZATION CROSS SECTIONS AND FRAGMENTATION OF U, UO, UO_2, AND UO_3. **Blackburn, P. E.; Danielson, P. M. (Argonne National Lab., Ill.). J. Chem. Phys.; 56: No. 12, 6156-64(15 Jun 1972).**

Electron-impact relative ionization cross sections and fragmentation patterns of U, UO, UO_2, and UO_3 were measured using 4- to 60-V electrons. Because the molecules are extensively fragmented, both total relative ionization cross sections and cross sections for production of parent ions are given. Values are tabulated as a function of ionizing voltage. The total cross sections at 40 V fail to conform to the additivity rule with the cross section of UO_3 about half of that for U. Five volts above threshold, the total cross section ratio of UO_3 to U is 0.08. Because of UO_3 fragmentation, a smaller ratio in terms of parent ions of 0.025 is found. All three oxide molecules are severely fragmented by electron impact. At 40 V 85% of the ions produced from UO_3 are fragments. For the U–O system, use of theoretical atomic ionization cross sections and the additivity rule leads to sizeable errors at high voltages and far greater errors at low voltage. (auth)

36941 DEPARTURE OF N_2^+(B $^2\Sigma_u^+$, v′ = 2 AND 3) VIBRATIONAL POPULATIONS FROM FRANCK–CONDON PREDICTIONS IN THE CASE OF ENERGETIC e–N_2(X $^1\Sigma_g^+$, v = 0) COLLISIONS. Pendleton, W. R. Jr. (Utah State Univ., Logan); O'Neil, Robert R. J. Chem. Phys.; 56: No. 12, 6260-2(15 Jun 1972).

Evidence is presented for a departure of the vibrational distribution of N_2^+(B $^2\Sigma_u^+$, v′) ions formed in single collisions of energetic electrons and N_2(X $^1\Sigma_g^+$, v = 0) molecules from that based upon a simple Franck–Condon model involving simultaneous ionization and excitation of the neutral molecules. Comparison of experimental N_2^+ first negative relative band intensities excited in such collisions with values computed using the method of Bates show that the theoretical and experimental results exhibit the same trend within each of the v″ progressions. However, in the progressions with v′ = 2 and 3, the experimental relative photon emission rates exceed the corresponding theoretical values by factors of 5 and 170, respectively. Possible explanations of this apparent departure from the Franck–Condon values are considered. (A.G.W.)

Atomic Theory

Refer also to abstracts 37569, 37570, 37583, and 37796.

36942 (ORO—4317-6) LOCAL EXCHANGE POTENTIAL FOR THE RELATIVISTIC HARTREE–FOCK EQUATIONS. Technical Report No. 72-113. Miller, L. D. (Maryland Univ., College Park. Dept. of Physics and Astronomy). May 1972. 11p. Dep. NTIS.

Within the relativistic Hartree–Fock framework, an exact local exchange potential is developed for closed-shell atoms which depends upon all relativistic single-particle quantum numbers except the magnetic quantum number m. This exchange potential should be useful for relativistic atomic Hartree–Fock calculations. (auth)

36943 ANALYSIS OF ATOMIC CORRELATION ENERGIES. **Katriel, J. (Nuclear Research Centre-Negev, Beer-Sheva, Israel). Chem. Phys. Lett.; 12: No. 3, 457-9(1 Jan 1972).**

Analysis of atomic correlation energies in terms of kinetic energy, nuclear attraction, and interelectronic repulsion is carried out for the isoelectronic sequences of two- to nine-electron atoms. Preliminary observations concerning the monotonicity with respect to the number of electrons and the inadequacy of the restricted Hartree–Fock scheme for the low nuclear charge numbers of the isoelectronic sequences are made. (auth)

36944 DIMENSIONAL AND NUMERICAL EQUIVALENCE OF THE SPACE-FILLING-CURVE APPROACH AND MULTI-DIMENSIONAL INTEGRATION METHODS FOR INTEGRAL-TRANSFORM TRIAL FUNCTIONS. **Somorjai, R. L.; Power, J. D. (National Research Council of Canada, Ottawa). Chem. Phys. Lett.; 12: No. 3, 502-7(1 Jan 1972).**

The pseudo-one-dimensional space-filling-curve approach of Rosenthal is shown to be dimensionally and numerically equivalent to explicitly multidimensional integration methods. However, other considerations render it computationally less attractive to apply. The importance of finding appropriate mappings onto the parameter space is stressed and demonstrated. Extremely accurate results are obtained for the S-limits of H^- and He, as well as for the exact He ground state, with low-order secular determinants and a single scale parameter. (auth)

36945 ELECTRON CORRELATION IN CLOSED-SHELL SYSTEMS. I. PERTURBATION THEORY USING GAUSSIAN-TYPE GEMINALS. Pan, Kee-chuan; King, Harry F. (State Univ. of New York, Buffalo). J. Chem. Phys.; 56: No. 9, 4667-88(1 May 1972).

The calculation of electron correlation energy in closed-shell atoms and molecules is approached using Rayleigh–Schroedinger perturbation theory with the symmetric sum of Hartree–Fock operators for H^0. The alleged advantages of using a V^{N-1} potential are questioned. Variational equations for first-order pair correlation functions are computed for He, Be, B^+, and Ne by expansion in linear combinations of correlated Gaussian-type geminal basis functions containing r_{12}^2 in the exponent. Such functions form mathematically complete sets, have convenient symmetry properties, and are integrable in closed form. An extensive search for optimum exponential parameters yielded trial functions for each of the ss orbital pairs giving better than 99% of the limiting second-order pair energy using only five basis functions per pair. Similar but less thorough studies of sp and pp pairs in neon are also reported. Careful attention is paid to computational accuracy. An upper bound of –0.3428 au is established on the second-order contribution to the correlation energy in neon. (auth)

36946 DENSITY LOCALIZATION OF ATOMIC AND MOLECULAR ORBITALS. I. von Niessen, W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich. IBM Research Lab., San Jose, Calif.). J. Chem. Phys.; 56: No. 9, 4290-7(1 May 1972).

A new intrinsic method for the localization of atomic and molecular orbitals is presented, which will be called (charge) density localization method. This new procedure follows an earlier suggestion of Edmiston and Ruedenberg. It is based on the minimization of the sum of the charge density overlap integrals of the orbitals: $\Sigma_{i<j}\int |\langle r|i\rangle|^2|\langle r|j\rangle|^2 d^3r$, $|\langle r|i\rangle|^2$ being the charge density of orbitals $|i\rangle$. Because of the physical relation between the exchange interaction of wave packets representing fermions and their mutual

overlap it is expected that this method is related to the energy localization procedure of Edmiston and Ruedenberg. The density localization method is applied to the atoms Be and Ne, where the four outer-shell localized orbitals point to the corners of a tetrahedron. The results are compared with those of other localization procedures. Good agreement is obtained. It is shown in the present and in forthcoming publications that the same physical situation can be described by different but physically equivalent pictures. (auth)

36947 THIRD-ORDER FEYNMAN DIAGRAMS FOR DEGENERATE STATES OF ATOMIC SYSTEMS. Ivanov, L. N.; Ivanova, E. P.; Safronova, U. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 31: No. 4, 263-5(Oct 1971).

Translated from Opt. Spektrosk.; 31: No. 4, 489-95(Oct 1971).

Energy levels of the states of the 1s2s, 1s2p, $1s^2 2s$, and $1s^2 2p$ configurations are investigated. For these states, the so-called terms with simple denominators and also the Hartree–Fock part of the third-order correction were calculated in the third-order perturbation theory. Terms with simple denominators include the Hartree–Fock correction and a part of the correlation correction that was relatively large. It is shown that the smallness of the total third order for the simplest atomic systems is explained by the appreciable compensation of the terms with simple denominators, which is disturbed by the filling of the shell with $n = 2$. (auth)

36948 ASYMPTOTIC EXPANSIONS IN 1/Z IN PERTURBATION THEORY FOR PROBABILITIES OF RESONANCE TRANSITIONS IN ATOMS. Khristenko, S. V.; Vetchinkin, S. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 31: No. 4, 269-72(Oct 1971).

Translated from Opt. Spektrosk.; 31: No. 4, 503-9(Oct 1971).

Dipole strengths for resonance transitions between highly excited states of atoms are expanded in a series of inverse powers of the principal quantum number n of the optical electron, within the limits of first-order perturbation theory for the electronic interaction. Numerical values are presented for the corresponding expansion coefficients for the transitions $1s^2nl\,^2L-1s^2n(l+1)\,^2L'$, $1snl\,^3L-1sn(l+1)\,^3L'$, and $1snl\,^1L-1sn(l+1)\,^1L'$ in the spectra of lithium, ortho-helium, and para-helium, respectively. Asymptotic formulas, corresponding to $n \gg 1$, are applicable right down to small n. (auth)

36949 DIAGONALIZATION OF THE HARTREE–FOCK HAMILTONIAN FOR OCCUPIED STATES. Kobe, Donald H. (North Texas State Univ., Denton). J. Chem. Phys.; 56: No. 12, 5990-2(15 Jun 1972).

A variational principle is found, which implies that the Hartree–Fock (HF) single-particle Hamiltonian for occupied states is diagonal. The Brillouin condition is recovered by stipulating that the arbitrary unoccupied orbitals be orthogonal to the occupied ones. When it is further stipulated that the unoccupied orbitals be orthonormal, the HF equation for occupied states is determined uniquely and no off-diagonal Lagrangian multipliers occur. (auth)

36950 CALCULATION OF THE MATRIX ELEMENTS OF THE OPERATORS OF THE ELECTROSTATIC INTERACTION ENERGY AND OF THE RELATIVISTIC CORRECTIONS TO IT. Rudzikas, Z. B.; Kanyauskas, Yu. M. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 11: No. 6, 967-82(1971). (In Russian).

Using the eigenvalues of the Casimir operators of the groups R_{2l+1}, SU_{2l+1}, and Sp_{4l+2}, it is shown that the coefficients of the radial integrals of the electrostatic interaction matrix elements are linearly dependent. This enables one to get a more convenient formula for the calculations of the matrix elements mentioned above. Analogous relations are also found in the case of the matrix elements of the operators of the relativistic corrections. The coefficients of the radial integrals of the two-electron matrix elements of these operators are expanded in terms of the orbital quantum number of one of the two electrons, the corresponding quantum number of the other electron being equal to three; they are presented in tables. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

36951 EFFECT OF A DISCONTINUITY IN DENSITY OR CONDUCTIVITY ON THE HYDROMAGNETIC STABILITY OF A VORTEX SHEET. Chakraborty, B. B. (Bombay Univ.); Jindia, R. K. J. Appl. Phys.; 43: No. 7, 3154-8(Jul 1972).

The hydromagnetic stability of a plane vortex sheet in incompressible, inviscid, and finitely conducting fluids is studied against small disturbances in the presence of a discontinuity in density or conductivity across the vortex sheet. In the equilibrium state the magnetic field is uniform and aligned with the direction of fluid motions. It is found that it is sufficient, for studying the stability of the vortex sheet, to consider only two-dimensional disturbances that travel along the magnetic field. A discussion of the dispersion relation in several different cases shows that a discontinuity in density or conductivity has a stabilizing influence on the vortex sheet. (auth)

36952 FLOW OF A CONDUCTING FLUID IN A CHANNEL WITH INSULATED WALLS IN A NONHOMOGENEOUS MAGNETIC FIELD. Brinzanescu, Ligia. Stud. Cercet. Mat.; 23: No. 10, 1495-1503(1971). (In Rumanian).

The steady flow in a plane channel with insulating walls of a nonviscous fluid having constant conductivity σ in a nonhomogeneous magnetic field is studied. At infinity the velocity V_0 of the fluid is considered constant and parallel to the walls of the channel. The case $R_M \ll 1$, where the induced magnetic field can be neglected, is considered. By using the Dragos method, the magnetohydrodynamic equation system is reduced to a system of two equations with partial derivatives for the functions Ψ (current function) and Ω (a function for the density of electric current). The solution of this system leads to the resolution of a singular integral equation. In the last part of the study, a system of successive approximations based on the development of the solution with respect to R_M and R_H is studied. It is shown how the approximation of any order of the solution can be determined directly. For the first-order approximation, the velocity profiles in different flow sections are traced. (tr-auth)

36953 UNIQUENESS OF MHD ALIGNED FLOWS WITH GIVEN STREAMLINES. Chandna, O. P.; Nath, V. I. (Univ. of Windsor, Ont.). Can. J. Phys.; 50: No. 7, 661-5(1 Apr 1972).

Physical conditions and geometric implications are determined if two stationary, MHD aligned flows have the same streamline patterns. This study is carried out for incompressible and irrotational compressible plane flows; incompressible axially symmetric flow and incompressible spatial doubly laminar flow. (auth)

36954 ELECTROHYDRODYNAMIC FLOW OF IDEAL INCOMPRESSIBLE FLUID IN PLANE AND CIRCULAR CHANNELS WITH ZERO CHARGED-PARTICLE MOBILITY. Semenova, I. P.; Yakubenko, A. E. Prikl. Mat. Mekh.; 35: 100-9(Jan-Feb 1971). (In Russian).

Distributions of electric potential and electric field in plane and circular channels with constant cross sections and infinite electrodes were determined for ideal incompressible fluid flow containing space charge. The influence of channel dimensions on the distribution of electric fields was estimated, assuming zero mobility of the charged particles and the limitations of one-dimensional theory. The solutions obtained corresponded to a zero approximation in the series expansion according to the interaction parameter for an ideal gas flow in a constant cross-sectional channel. The influence of electrodynamic effects on hydrodynamic flow was also resolved in a first approximation. (R.V.J.)

36955 NUMERICAL SOLUTION OF THE EQUATIONS OF THE DYNAMO THEORY OF TERRESTRIAL MAGNETISM. II. RESULTS. Kropachev, E. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 11: No. 5, 737-43(1971).

Translated from Geomagn. Aeron.; 11: No. 5, 875-82(1971).

The results of a numerical solution of the system of MHD equations for the core of the Earth are reported. The electromagnetic field and hydrodynamic velocities, including the magnetic moment of the core, are found to change very rapidly. For this reason, it is practically impossible to integrate the system of MHD equations for a long period of time, comparable to the period of relaxation of the dipole moment. (auth)

36956 SOME PROPERTIES OF ALIGNED MHD FLOWS. Chandna, O. P.; Nath, V. I. (Univ. of Windsor, Ont.). Jap. J. Appl. Phys.; 11: No. 6, 889-92(Jun 1972).

The flow considered is steady; the magnetic lines are everywhere parallel to the streamlines and the fluid is infinitely conducting and nonviscous. If the density is constant along each individual streamline, then any flow field satisfying the flow equations is a member of an infinite group of flow fields sharing the same streamlines. If one of the four scalar quantities, the speed V, the density ρ, the pressure p and the speed of sound c, is constant along each streamline in a plane flow then the other three, together with the vorticity ω, are also constant along each streamline; the streamlines are either concentric circles or parallel straight lines. Converses are also true. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 36203, 36674, 36677, and 36681.

36957 (ANL/HEP–7208(Vol.1)) PLANNING FOR THE FUTURE. ZERO GRADIENT SYNCHROTRON WORKSHOPS, SUMMER 1971. Proceedings of a Series of Seven Workshops Held at Argonne National Laboratory, June 3–August 5, 1971. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 395p. Dep. NTIS.

The workshop included 32 papers. Separate abstracts were prepared for all papers. (J.F.P.)

For abstracts of individual papers see: 36200, 36201, 36680, 36681, 36958, 37037–37039, 37070, 37071, 37106–37116, 37210–37213, 37226, 37246–37248, 37259, 37301, and 37528.

36958 (ANL/HEP–7208(Vol.1), pp 248-51) NUCLEAR LEVELS AS ANALYZERS OF HIGH ENERGY INTERACTIONS. Piccioni, O.; Bowles, P.; Garland, R.; Kirk, P.; Mehlhop, W.; Marraffino, J.; Scipione, D.; Murty, S. (California Univ., San Diego). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

An experimental program is described to explore the possibility of using nuclear excited states which are gamma emitters to study high energy interactions such as the production of multiparticle resonances and to furnish information about elastic interactions of various particles with nucleons. (J.F.P.)

36959 RESULTS AND PROSPECTS OF INVESTIGATING HIGH-ENERGY MUONS PRODUCED BY COSMIC RAYS. Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; (and others) (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 41-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Experimental data are given in favor of the existence of direct muon production. Experiments which could be carried out on the moon, where there is no atmosphere, open new possibilities of investigating direct muon production, since in such conditions the $\pi \rightarrow \mu$ and $K \rightarrow \mu$ decay processes are suppressed. As a result, direct production would give rise to a number of muons 10 times larger than that due to trivial decay processes even at $E_\mu \gtrsim 10^{11}$ eV, whereas on the earth the excess due to direct production amounts only to a few percent. (auth)

36960 PROCEEDINGS OF THE 11th INTERNATIONAL CONFERENCE ON COSMIC RAYS. VOLUME 3. HIGH ENERGY INTERACTIONS AND EXTENSIVE AIR SHOWERS. Somogyi, A. (ed.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 1-766(1970). (CONF-690814–(Vol.3)).

The conference included 121 papers. Separate abstracts were prepared for all papers. (J.F.P.)

For abstracts of individual papers see: 36735–36740, 36961–36965, 36981–37034, 37080–37102, 37128–37130, 37144, 37145, 37176–37194, 37237–37241, and 37287–37290.

36961 SEARCH FOR QUARKS AMONG DELAYED PENETRATING PARTICLES NEAR AIR SHOWER CORES. White, G. M.; Prescott, J. R. (Univ. of Calgary, Alberta). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 31-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

This experiment has used two timing scintillators and a small extensive air shower array to search for quarks near the cores of EAS. The arrival times of the first two penetrating particles after an air shower front were measured and those showers having at least one such particle were examined with the array. No nontrivial differences in the shower parameters were found when the EAS were examined for differences in the values of the arrival time. The average delay of the first penetrating particle lay in the interval 2.9 to 4.0 ns behind the shower front and the spectrum of the underlying distribution function was found to drop off sharply for small values of delay and then to decrease more slowly with a time constant of about 17 ns. No unusual number of long delayed particles that might be identified with quarks of high mass and small Lorentz factor was detected and a 90% upper confidence limit to the quark flux in those regions close to air shower cores is 4×10^{-10} cm^{-2} sec^{-1} sr^{-1}. (auth)

36962 SEARCH FOR QUARKS BEYOND THE ATMOSPHERE ON THE PROTON-3 SATELLITE. Grigorov, N. L.; Kakhidze, G. P.; Rapoport, I. D.; Savenko, I. A. (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 37-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A search for quarks was carried out beyond the atmosphere on the Proton-3 satellite using an elementary particle spectrometer. The upper limits of the quark flux and the quark generation cross section have been determined as a result of these measurements. (auth)

36963 SEARCH FOR QUARKS IN COSMIC RAYS AT SEA LEVEL AND AT MOUNTAIN ALTITUDE. Chin, S. (Osaka City Univ.); Hanayama, Y.; Hara, T.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 57-61(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Using a telescope consisting of 6 layers of plastic scintillation counters and 4 layers of wire spark chambers with an aperture of 3800 cm^2 sr, a search for fractionally charged particles in cosmic rays was carried out at sea level and at 2770 m above sea level. A search for relativistic $\frac{1}{3}$ e-quarks in cosmic rays was made for 2050 hours at sea level and for 5500 hours at mountain altitude. No strong evidence for the existence of the quarks was found, and the upper limits of the flux of quarks at sea level and at mountain altitude, with 90% confidence level, are $I(\frac{1}{3}e) \leq 1.3 \times 10^{-10}$ cm^{-2} sr^{-1} sec^{-1} and $I(\frac{1}{3}e) \leq 5.7 \times 10^{-11}$ cm^2 sr^{-1} sec^{-1}, respectively. (auth)

36964 EMPIRICAL RELATIONS AMONG THE PARAMETERS CHARACTERIZING THE ANGULAR DISTRIBUTIONS OF SECONDARIES IN COSMIC-RAY JETS. Gierula, J.; Wojnar, E. (Inst. of Nuclear Physics, Krakow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 119-23(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

For 1042 cosmic ray jets produced by singly charged and neutral primaries in nuclear emulsion, estimates of the primary energy, of the anisotropy of the angular distribution of secondaries, and of a parameter measuring the shape of the distribution were calculated together with their statistical errors. A systematic increase of anisotropy with energy is accompanied by a systematic change in the shape of the angular distribution. (auth)

36965 STUDIES OF SOME CHARACTERISTICS OF INELASTIC INTERACTIONS AT ENERGIES HIGHER THAN 200 GeV. Berdzenishvili, O. L.; Gabunia, L. L.; Garibashvili, D. I.; (and others) (Inst. of Physics, Tbilisi, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 215-18(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The momentum distribution and energy distribution of secondaries produced in 18 nuclear interactions observed by two cloud chambers and an ionization calorimeter at Tskhra–Tskaro were determined. The correlation between the longitudinal and transverse momenta of the secondaries was found to be due to experimental conditions rather than to a tone relation between these quantities. (auth)

36966 QUARK CANDIDATES AMONG DELAYED SHOWER PARTICLES AT 70 m W.E. UNDERGROUND. Dardo, M. (CNR; Turin. Univ., Turin); Navarra, G.; Penengo, P.; Sitte, K. Nuovo Cim.; 9A: No. 3, 319-39(1 Jun 1972).

An arrangement of five telescopes, each consisting of three scintillators separated by 150 g/cm^2 of lead, was operated at the Mt. Cappuccini station, 70 m w.e. underground. The pulses of all fifteen detectors were displayed on two dual-beam oscilloscopes, so that interactions originating in the rock and in the absorbers could be identified, and time delays in the traversals measured. Altogether about 16,000 showers were recorded. The analysis of 6,000 events striking two telescopes showed a frequency of small pulses much in excess of that found for single muons. Moreover, a significantly larger fraction of the small pulses occurred delayed with respect to the first traversal with an average delay of about 14 ns. Also, for small-pulse events the rate of interactions initiated in the lead absorbers followed an exponential law with an interaction mean free path of between (500 ± 100) and (630 ± 80) g/cm^2, while for the others it was consistent with that expected for a mixture of muons and locally produced pions. Similar interaction characteristics were found for multiple showers. Here again small pulses occurred predominantly after triggering normal pulses, with a delay distribution very similar to that observed for pairs, and a mean delay of about 11 ns. The sequences of small and large pulses were quite inconsistent with those expected for random fluctuations. Thus the small-pulse events bear all the features characteristic of quarks. However, their flux is of the order of a few $10^{-8}/\mathrm{cm}^2$ sr s, at least two orders of magnitude higher than the upper limits of quark fluxes reported in other experiments. Since some, but perhaps not all, of this discrepancy can be explained by the differences in the experimental conditions, the interpretation must remain tentative. (auth)

Electromagnetic

Refer also to abstracts 37178 and 37406.

36967 (JINR–P1-6361) CASCADE CURVES AND FLUCTUATIONS OF THE AVERAGE CHARACTERISTICS OF THE DEVELOPMENT OF SHOWERS PRODUCED BY 1600 MeV GAMMA-QUANTA IN LIQUID XENON. Slovinskii, B.; Strugal'skii, Z.; Khubert, V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

The process of development of the electron-photon showers produced by 1600 MeV γ-quanta in liquid xenon was studied. The results are presented in the form suitable for the development of the technique of the γ-quanta energy determination according to the showers produced. In particular, information is given about fluctuations of the complete range of the observed shower electrons corresponding to certain depths of the shower development. (auth)

36968 STUDY OF THE INCLUSIVE REACTION $\gamma p \rightarrow \pi^- +$ (ANYTHING) WITH POLARIZED PHOTONS AT 2.8, 4.7, AND 9.3 GeV. Moffeit, K. C. (Stanford Univ., Calif.); Ballam, J.; Chadwick, G. B.; (and others). Phys. Rev., D; 5: No. 7, 1603-21 (1 Apr 1972).

The inclusive spectra of π^- mesons from the events obtained in three exposures of the SLAC 82-in. hydrogen bubble chamber to a nearly monochromatic polarized photon beam of mean energies 2.8, 4.7, and 9.3 GeV. The data are presented in terms of transverse momentum $p_\perp$ and three suggested choices for the other independent variable, i.e., the longitudinal momentum $p_{||}$ in the laboratory system, the rapidity variable $y = \frac{1}{2} \ln[(E + p_{||})/(E - p_{||})]$, and the variable suggested by Feynman $x = p_{||}^* / p_{\max}^*$ in the c.m. system. The 4π geometry of the bubble chamber allows us to cover the entire kinematically allowed range of these variables. It is shown that exact limiting fragmentation does not occur at our energies, but the data are compatible with an approach to a limiting distribution as $A + Bs^{-1/4}$. The qualitative features of the structure function $f(x,p_\perp^2)$ in terms of Feynman's x variable are similar at the three energies. Quantitatively, 5 to 10% differences between the 4.7- and 9.3-GeV data near $x = 0$ are found. $f(x,p_\perp^2)$ is not factorizable into independent functions of x and $p_\perp^2$. For the data the mean π^- multiplicity is described well by $\langle n^- \rangle = c^- \ln s + d^-$, where $c^- = 0.44 \pm 0.04$ and $d^- = 0.07 \pm 0.08$. Following the procedure suggested by Bali et al., c^- is calculated from the experimentally observed 9.3-GeV structure function at $x = 0$ and $c^- = 0.44 \pm 0.02$ is found in agreement with the value obtained directly. A correlation is found between the azimuth of the π^- and the photon polarization plane only for $x > 0.3$ when elastic ρ^0 photoproduction is excluded. Lastly, it is noted that the distribution of π^- longitudinal momentum is not symmetric in the "quark frame" where $p_{\mathrm{target}} = 1.5 p_{\mathrm{beam}}$. (auth)

36969 TOTAL HADRONIC CROSS SECTION OF γ RAYS IN HYDROGEN IN THE ENERGY RANGE 0.265 TO 4.215 GeV. Armstrong, T. A. (Univ. of Glasgow); Hogg, W. R.; Lewis, G. M.; (and others). Phys. Rev., D; 5: No. 7, 1640-52(1 Apr 1972).

The total cross section of γ rays in hydrogen resulting in hadron production, σ_T, was measured over the energy range 265 to 4215 MeV. A tagging system with narrow energy bins was employed. Structure in the resonance region followed by a steady fall with energy was observed and the results are analyzed. The forward amplitude of γ-proton scattering is evaluated, and its behavior in the Argand diagram studied as a function of energy. The relationships of the measurements to Regge-pole theory and the vector-dominance model are detailed. (auth)

36970 REACTION $K^-p \rightarrow \Xi^- K^0 \pi^+$ AT 2.18 GeV/c. Borenstein, Samuel R. (Brookhaven National Lab., Upton, N. Y.); Danburg, Jerome S.; Kalbfleisch, George R.; (and others). Phys. Rev., D; 5: No. 7, 1559-64(1 Apr 1972).

From 730 $K^-p \rightarrow \Xi^- K^0 \pi^+$ events at 2.18 GeV/c a sample of 324 $\Xi^{*0}(1531)$ decaying to $\Xi^- \pi^+$ was analyzed. This sample yields a mass $M = 1531.3 \pm 0.6$ MeV, corrected for systematic shifts. A width of $\Gamma = 8.4 \pm 1.4$ MeV is obtained; the mass resolution was unfolded taking account of the non-Gaussian nature of the resolution function. In addition, the $\Sigma^{*0}(1635)$ reported by the Brandeis-Maryland-Syracuse-Tufts Collaboration is not detected. An upper limit of less than 2 μb (90% confidence level) is obtained for the cross section. The energy dependence of the ΞK and $\Xi^*(1531)K$ cross sections would suggest a substantial cross section ($\sim 7.5 \pm 3$ μb) for $\Xi^*(1635)K$ at 2.18 GeV/c. Thus either this state does not exist, or the energy dependence of its production cross section is different from that observed for the ΞK and $\Xi^*(1531)K$ reactions. (auth)

36971 PHOTOPRODUCTION OF π^0-MESONS ON NUCLEONS IN A COMPLEX REGGE POLE MODEL. Zotov, N. P.; Rakov, Yu. A.; Tsarev, V. A. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz., 15: No. 3, 553-6(Mar 1972). (In Russian).

The experimental data on the photoproduction of π^0-mesons on nucleons are described in a model which takes into account the ω- and ρ-mesons complex Regge poles. (auth)

36972 THRESHOLD PION ELECTROPRODUCTION AT TRANSFERRED MOMENTA UP TO 10.4 F^{-2}. Titov, Yu. I.; Severin, N. F.; Afanas'ev, N. G.; (and others) (Physical-Technical Inst., Moscow). Yadern. Fiz.; 15: No. 3, 492-6(Mar 1972). (In Russian).

The cross section of the threshold pions electroproduction at transferred four momenta squared 5.19 and $10.4 F^{-2}$ was measured. In the frame of the modified isobar model the neutron charge form factor was obtained from these data (-0.17 ± 0.04 and -0.085 ± 0.035 respectively). The value of the axial vector nucleon form factor F_A was determined with using of the current algebra methods and of the PCAC hypothesis. The complete analytic approximation of F_A is given, the result is coincided with neutrino experimental data. (auth)

36973 HORIZONTAL AIR SHOWERS. Boehm, E.; Fritze, R.; Kunstmann, J.; (and others) (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 121-4(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Air showers with zenith angles >65° were recorded using an array comprising six 1 m^2 scintillation counters in conjunction with the Kiel "vertical" air shower array. The horizontal showers (HEAS) were selected by fast timing methods and track length measurements in the 32 m^2 neon hodoscope. Preliminary results on the zenith angle distribution, intensity, and muon content of HEAS are reported. (auth)

36974 OBSERVATION AND INTERPRETATION OF HORIZONTAL AIR SHOWERS OF ENERGIES ABOVE 10^{13} eV. Hara, T. (Tokyo Univ.); Kawaguchi, S.; Mikamo, S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 125-31(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The observation of horizontal air showers (HAS) was continued during these four years with the air shower array at the Institute for Nuclear Study, University of Tokyo. The integral size spectrum is expressed by $N^{-2.8 \pm 0.3}$ in the size region of 10^3 to 10^5 for horizontal air showers of zenith angle above 70°. It is found that the zenith angle distributions for three size regions (0.5 to 1) $\times 10^4$, (1 to 2) $\times 10^4$ and (2 to 4) $\times 10^4$ increase as sec θ between 60 and 75° and decrease above 75 ± 5° with an attenuation length of 2000 to 10,000 $\mathrm{g/cm}^2$, within statistical uncertainties. The proportion of nuclear cascade showers to the total showers is estimated to be several tens percent in the size region of 3×10^3 to 6×10^4. To explain consistently the experimental results mentioned above as well as the depth-intensity relation of muons and burst size spectrum observed underground, an analysis was made under an assumption of muons as parents of the horizontal air showers. The results are as follows: The nuclear interaction cross section of the muon increases as E^α ($\alpha \approx 0.5$) from a few times 10^{10} eV to 10^{14} eV and the inelasticity is around 0.5. The integral energy spectrum of muons at sea level is expressed by $E^{-2.8 \pm 0.3}$ from 10^{12} eV to 10^{14} eV. But the decrease in the intensity above 75° is not explained by the assumption. Other possibilities of some unconfirmed particles such as a heavy triplet, for the parent of HAS, are not excluded. (auth)

36975 MULTIPLICITY SPECTRUM OF MUON SHOWERS FAR UNDERGROUND. Ozaki, S.; Coats, R. B.; Stenerson, R. O.; (and others) (Univ. of Utah, Salt Lake City). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 203(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The multiplicity spectrum of muon showers was observed at depths of 1400 to 3400 $\mathrm{hg/cm}^2$ underground. (auth)

36976 COMBINED METHOD OF EMULSION CHAMBER AND IMAGE INTENSIFIER SYSTEM FOR STUDY OF HADRONS IN AIR

SHOWERS. Machida, M. (Yamanashi Univ., Japan); Tsushima, I.; Matano, T.; Machida, M.; Tanahashi, G. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 427-32(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The combined method of emulsion chamber and scintillator–image intensifier system is proposed for the investigation of the hadronic component of air showers. The position and size of a burst produced by a hadron in the emulsion chamber are determined by the image on the phosphor screen of the image intensifier tube. A preliminary experiment using this method is described. (auth)

36977 OBSERVATION OF RESONANCE TRANSITION RADIATION FROM RELATIVISTIC ELECTRONS. Hoshino, K.; Ohashi, Y.; Okada, A.; Taira, K.; Yokoi, K. (Nagoya Univ., Japan). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 443-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An observation was made on the resonance transition radiation which occurred when electrons of energy 0.6 to 1.2 GeV passed through several kinds of layered media. The purpose of this experiment was to get basic data for developing a Lorentz-factor-selecting threshold counter applicable to Lorentz factors > 1000. The radiation photons were detected by a PR-gas proportional counter. First, the total yield of photons, second its dependence on the electron energy, on the number of layers and on the period of the medium, and third, the shape of the photon spectra were all investigated. Present experimental conditions made the observation of the first harmonic component of the radiation possible. A fairly good agreement between theory and experiment was observed in the first place and, in the second, the absolute yield observed indicated the feasibility of the Lorentz-factor-selecting threshold counter. (auth)

36978 METHOD OF FINDING DIRAC'S MAGNETIC MONOPOLES. Dadykin, V. L. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 461-3(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An experiment is suggested to find fast cosmic monopoles by detecting their Cerenkov radiation in air. The required equipment consists of about 100 multipliers and about 1000 Geiger counters. The apparatus must have a collecting power of about 10^3 m^2 sr and has to be placed in a salt mine. (auth)

36979 ELECTROMAGNETIC FORM FACTOR OF PROTONS FOR TIME-DEPENDENT MOMENTUM TRANSFER. Pfister, Herbert (Univ. Tuebingen, Ger.). Fortschr. Phys.; 19: No. 1, 1-25(1971). (In German).

The imaginary parts of both form factors G_E and $G_{M_2/\mu}$ have at $t \approx 0.25$ (GeV)^2 a sharp maximum, somewhere over the e mass, pass through zero, and then reach a flat minimum. The accurate position of the zero transition and of the minimum depends on which asymptotic behavior was assumed in the analytical treatment. The slight deviation from the scalar law in the space-like region leads in the second-type region to significance between G_E and $G_{M/\mu}$. The zero transition of Im G_E in the total range $t > 0.4$ (GeV)^2 is significantly larger than $|G_{M/\mu}|$. At the threshold for the process $e^+ + e^- \rightarrow p + \bar{p}$ at $t = 4M_p^2$ the results point to the equality of G_E and G_M, which is to be expected theoretically. All these data are in the region 0.4 (GeV)$^4 < t < 1.5$ (GeV)^2 with an uncertainty of about 30%; in the usual t-region there are greater uncertainties. (tr-auth)

36980 SMALL ANGLE SCATTERING OF ELECTRONS BY PROTONS. Akimov, Yu. K.; Andert, K.; Kazarinov, Yu. M.; (and others) (Erevan Inst. of Physics. Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1231-7(Apr 1972). (In Russian).

The differential cross sections for elastic electron-proton scattering with small momentum transfer ($0.195 \leq q^2 \leq 0.506F^{-2}$) are measured with the internal beam of the 4.4 GeV electron accelerator. Silicon detectors and a polyethylene film target are employed. The results of the measurements yield data on the form factor of the proton and its mean root square radius. (auth)

36981 SEARCH FOR COSMIC MAGNETIC MONOPOLES. Fleischer, R. L. (General Electric Research and Development Center, Schenectady, N. Y.); Hart, H. R. Jr.; Jacobs, I. S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 27-30(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A search for magnetic monopoles in nature was made in order to try to establish whether they exist and to test whether the high energy component of cosmic rays ($>10^{17}$ eV) could be cosmic monopoles. Old magnetic materials from ocean bottoms were searched for cosmic monopoles which would have been trapped after being slowed to thermal velocities by the earth's atmosphere and the ocean. Also old minerals were searched for tracks of energetic monopoles. From the failure to observe monopoles it is concluded that the high energy cosmic rays do not contain an abundance of monopoles in the energy range up to 10^{19} eV unless the monopoles possess a mass >150 (proton masses) and a magnetic pole strength of $<\hbar c/e$ (i.e. < half the minimum charge inferred by Schwinger). With this limitation the flux of monopoles onto the earth is less than $\frac{1}{2}$ monopole/cm^2/(age of the earth). (auth)

36982 PROPERTIES OF STRONGLY INTERACTING SHOWER PARTICLES AT 70 mwe UNDERGROUND. Dardo, M. (Univ., Turin); Navarra, G.; Penengo, P.; Sitte, K. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 41-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Earlier measurements at the Mt. Cappuccini station, 70 MW(e) underground, indicated the presence of a group of strongly interacting shower particles with properties characteristic of particles considerably more massive than nucleons. The experiment was continued with an enlarged and improved arrangement consisting of five telescopes, each made of three scintillators separated by two layers of lead. A preliminary analysis of the multiplicity distribution of incident showers, and of the interaction characteristics observed for showers of two penetrating particles, is presented. Within the statistical uncertainties the new results confirm the earlier findings. But because of the paucity of the sample analyzed (483 events) this conclusion is still very preliminary. (auth)

36983 FAMILY OF γ QUANTA WITH THE ENERGY OF 130 TeV. Baradzei, L. T.; Kanevskaya, E. A.; Smorodin, Yu. A.; Solov'ev, M. V. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 91-3 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Experimental data of a family of γ-quanta with the total energy of 130 TeV are given. The family was formed by the decay of π^0-mesons produced in nuclear interaction and suffered small cascade multiplication. This family is a certain example of production of a cluster with mass in the range of several GeV at an energy of more than 10^{14} eV. (auth)

36984 GENERAL RESULTS FROM THE HAVERAH PARK LARGE EAS ARRAY. Andrews, D.; Evans, A. C.; Hughes, R. R.; (and others) (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 337-42(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

General properties of the Haverah Park 2 km E.A.S. array are briefly discussed, and the proposed approach to the analysis of inclined showers is outlined. Then three quite separate topics are considered: the observation of an extremely inclined shower of high primary energy; decoherence measurements which are compared with the earlier work of Matano et al.; delayed particles at distances of ≥ 1 km from the axis of large showers. (auth)

36985 ENERGY-LOSS SPECTRUM OF SHOWERS WITH $E_p \geq 10^{18}$ eV. Andrews, D.; Evans, A. C.; Reid, R. J. O.; (and others) (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 343-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An energy loss spectrum was measured from data on near vertical showers of $E_p \geq 10^{18}$ eV. The energy spectrum from 10^{17} to 10^{19} eV was estimated via recent model calculations and is compared with other data. The arrival directions of the showers are briefly discussed. (auth)

36986 DERIVATION OF THE EAS SPECTRUM. Hillas, A. M. (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 355-60(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Measurements of the size or energy spectrum of extensive air showers require detecting arrays of widely different dimensions, and the shower sizes obtained with different arrays are not always directly comparable, as different methods are used for deriving "N" from the observations. An attempt is made to put the results of different experiments on a common scale, and it is pointed out that for very large showers there are several advantages in using the signal size at a certain fixed distance from the axis (perhaps 400 to 500 m) as the initial measure of a shower size. An empirical, calorimetric method is then used to relate shower sizes to primary energies, and good agreement is found between the energy spectra up to $>10^{19}$ eV obtained from various experiments by the empirical method and from model calculations. (auth)

36987 OBSERVATION OF AIR SHOWERS OF ENERGIES ABOVE 10^{18} eV. Hara, T.; Kawaguchi, S.; Mikamo, S.; (and others) (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 361-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Three stations with a pair of 2 m^2 scintillation detectors separated by 50 m were operated to observe large air showers. These three stations compose a triangle of sides 850 m, 1300 m and 1850 m. The Institute for Nuclear Study (INS) AS array inside this triangle array was operated simultaneously. Density distributions at the three distances mentioned above support the conclusion that the primary energy spectrum above 10^{18} eV is expressed as $kE^{-2.6}dE$. The ratio of density of all particles measured with scintillation detectors to that measured with a spark chamber is 1.28 ± 0.16 at distances of 180 m to 760 m from the shower axis for air showers of sizes 5×10^8 to 3×10^9. The density of muons above 5 GeV fluctuates considerably at the same distances and for the same sizes as above. The physical implication of this fluctuation is discussed. A preliminary experiment to detect radio echo from very large air showers is continued. The reflection of radio waves from sea waves contributes to the background for the detection and its character is carefully investigated. (auth)

36988 DETECTION OF THE ATMOSPHERIC SCINTILLATION LIGHT FROM AIR SHOWERS. Hara, T.; Ishikawa, F.; Kawaguchi, S.; (and others) (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 369-76(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A preliminary experiment to follow the development of air showers in the atmosphere and to estimate the interaction m.f.p. of the primary particles with energies of 10^{17} eV to 10^{19} eV is reported. A 160-cm telescope with 24 photomultipliers recorded light pulses from the showers. There were 15 events identified as air showers at distances larger than 0.6 km from the low angular velocities of the incident light. One event is very likely due to the atmospheric scintillation light from an air shower whose primary energy and distance are about 10^{19} eV and 3 km, respectively. (auth)

36989 ENERGY SPECTRUM OF COSMIC RADIATION FROM 10^{10} TO 2×10^{20} eV. Brownlee, R. G.; Chapman, G. J.; David, S. A.; (and others) (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 377-82(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Using the Sydney giant air shower array, the primary cosmic radiation energy spectrum is derived for energies up to $2(10)^{20}$ eV. A clear change of slope (termed the "ankle") is evident at energies of around 10^{19} eV. There is no sign of the spectrum truncating. The differential slope before the ankle is seen to be $-3.2^{+0.3}_{-0.2}$; whilst past 10^{19} eV it appears to be very flat at $-20^{+0.3}_{-0.4}$. (auth)

36990 ARRIVAL DIRECTIONS OF HIGH-ENERGY COSMIC-RAY PRIMARIES. Brownlee, R. G.; David, S. A.; Fisher, A. J.; (and others) (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 383-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The arrival directions of cosmic ray primary particles were determined for primary energies $5(10)^{14}$ to $5(10)^{20}$ eV using Geiger counter and cloud chamber arrays in Dublin, Jamaica and Sydney and the Sydney 100 km^2 air shower detector in the Pilliga State Forest, N.S.W. (auth)

36991 TIME DISTRIBUTION OF CHERENKOV LIGHT IN EXTENSIVE AIR SHOWERS. Sitte, K. (Lab. of Cosmic-Geophysics, Turin. Univ., Freiburg i. B.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 389-94(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The arrival time distribution of electrons in the front of extensive air showers, resulting from lateral scattering, is calculated as a function of the shower age. Applying this to the time distribution of Čerenkov light it is shown that for a narrow-angle detector the variation of the pulse height with time will be considerably faster, but remains affected by the shower age. This permits the use of Čerenkov detectors for age classification, instead of the more intricate methods required up to now. (auth)

36992 POSSIBLE CHANGE IN THE CHEMICAL COMPOSITION OF COSMIC PARTICLES AT ENERGIES ABOUT 10^{16} eV. Catz, Ph. (Cosmic Ray Physics Lab., Verrieres le Buisson, France); Maze, R.; Gawin, J. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 395-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A new analysis of angular measurements of EAS axis inclinations enables one to scan in a relatively wide primary energy range the change of the ratio of the muon to the electron component in EAS. An effect is obtained which may be interpreted as a change in the primary composition at energies about 10^{16} eV. The effect also gives some indication that the average primary mass at 10^{15} eV is lower than that at 10^{10} eV. (auth)

36993 ANGULAR DISTRIBUTION OF MUON-POOR EXTENSIVE AIR SHOWERS. Catz, Ph. (Cosmic Ray Physics Lab., Verrieres le Buisson, France); Maze, R.; Gawin, J.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 399-401(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The angular distribution of mu-poor extensive air showers was found to be flatter than that of normal showers. The result excludes any possibility that mu-poor showers are initiated by primary photons. It is likely that the showers are generated by some relatively passive particles which are produced through interactions between primary cosmic rays and atmospheric nuclei. (auth)

36994 ANALYSIS OF MUON-POOR SHOWERS. Escobar, I.; LaPointe, M.; Yodh, G. B. (Univ. of Maryland, College Park). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 403-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The Bolivian air shower experiment on Mt. Chacaltaya in Bolivia has yielded about 14,000 hours of muon-poor air shower data. These showers are predominantly electromagnetic in nature and include events which are the most promising candidates for air showers initiated by primary gamma rays above 10^{13} eV. To establish a special origin for these showers it must be shown conclusively that they exist as a separate class of showers with one or more parameters showing a distinct difference from ordinary proton initiated events. Efforts are being directed towards a better understanding of the muon content of these events. The muon content of ordinary showers was studied in detail, and found that the radial dependence was somewhat steeper than reported previously. Also a flattening was found in the size dependence of the muon content below 10^6. With the knowledge of the size and radial dependence one can make a better comparison between the muon-poor and the ordinary showers. The method used is outlined. (auth)

36995 HAVERAH PARK: THE FIRST TEN YEARS. Wilson, J. G. (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 409-14(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The Haverah Park EAS array and its history are described, and the results of measurements are summarized. (auth)

36996 SIDERAL DISTRIBUTION OF ARRIVAL DIRECTIONS OF EXTENSIVE AIR SHOWERS CONTAINING HIGH-ENERGY HADRONS. Fritze, R.; Samorski, M.; Staubert, R.; Truemper, J.; Boehm, E. (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 415-16(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The distribution in right ascension for different samples of showers containing high energy hadrons was investigated. No statistically significant deviations from isotropy were found. (auth)

36997 MULTIPLE CORES AND TRANSVERSE MOMENTA IN EXTENSIVE AIR SHOWERS. Samorski, M.; Staubert, R.; Truemper, J.; (and others) (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 417-22(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An analysis of shower cores observed with the Kiel neon hodoscope shows that there is no experimental evidence for the existence of genuine multicores requiring anomalously large transverse momenta. This applies to the whole size range investigated ($N = 10^4$ to 5×10^6). At the upper end of this size range the measured electron distributions are essentially consistent with single cores comprising Poissonian fluctuations only. In showers of small sizes local hadronic interactions represent the dominating background effect. Upper limits on the frequency of large transverse momentum events are presented. (auth)

36998 MUONS IN AIR SHOWERS OF ENERGIES ABOVE 10^{17} eV. Suga, K. (Tokyo Univ.); Shibata, S.; Mikamo, S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 423-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Muons in air showers were observed with 60 m^2 shielded detectors of the Bolivian Air Shower Joint Experiment on Mt. Chacaltaya in Bolivia. Primary cosmic ray particles above 10^{17} eV are concluded to be mainly protons, from the very narrow distribution of the number of muons. Bursts produced by high-energy muons in air showers with sizes above 5×10^7 in the shielding material of the 60 m^2 detector were also observed. The energy spectrum of muons obtained from the burst size spectrum is $E_u^{-2.2}\ dE_\mu$ at a distance of 100 m for E_μ < 300 GeV. (auth)

36999 INVESTIGATION OF THE ELECTRON, NUCLEAR-ACTIVE, AND MUON COMPONENTS OF EXTENSIVE AIR SHOWERS. Vernov, S. N.; Khristiansen, G. B.; Vedeneev, O. V.; (and others) (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 429-34(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The experimental EAS distributions for different parameters and also data concerning the correlation between them in showers with a fixed size N_e and with a fixed number of muons N_μ are presented. Compared with the results presented at the previous conference, the statistics were improved by a factor of two. The preliminary results obtained using a new improved array for EAS investigation are also presented. (auth)

37000 THREE-DIMENSIONAL MONTE CARLO SIMULATION OF THE NUCLEAR-ACTIVE COMPONENT OF EXTENSIVE AIR SHOWERS. Fomin, Yu. A.; Khristiansen, G. B. (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 435-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The energy spectrum and the lateral distribution of the energy flux of nuclear active particles were calculated on the basis of various models of the elementary interaction. The best agreement with experimental data is obtained in case of the isobar model and by assuming small values for the atomic numbers of the primary particles. (auth)

37001 TeV HADRONS IN AIR-SHOWER CORES. Fritze, R.; Samorski, M.; Staubert, R.; (and others) (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 439-45(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The 14 m^2 shielded neon hodoscope of the Kiel air shower array was used to study the hadronic component of air shower cores. Energy spectra and lateral distributions of about 1000 hadrons with energies between 1 and 30 TeV are presented. The spectra are corrected for a contamination of muon-induced cascades, which can be recognized by an analysis of the age parameters of the cascades. Spectra and lateral distributions are compared with results from Monte Carlo simulations of air showers. (auth)

37002 CHEMICAL COMPOSITION OF COSMIC RADIATION AT 10^{16} eV. Truemper, J.; Boehm, E.; Fritze, R.; Samorski, M.; Staubert, R. (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 447-50(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The fluctuations of energy flow of high energy hadrons in air shower cores were measured using the 14 m^2 neon hodoscope of the Kiel array. A comparison of experimental results with the Monte Carlo calculations of Bradt et al. yields information on the primary particle composition. The data are consistent with a mixed composition at primary energies of 4×10^{15} to 10^{16} eV. (auth)

37003 OBSERVATION OF THE HADRONIC COMPONENT OF EXTENSIVE AIR SHOWERS WITH EMULSION CHAMBERS COMBINED WITH SCINTILLATION DETECTORS. Matano, T. (Saitama Univ., Urawa, Japan); Machida, M.; Ohta, K.; Tanahashi, G. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 451-62(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

In order to study the extremely high-energy hadronic component of air showers, 16 emulsion chambers each of area 0.25 m^2 were installed in the center of an air shower array. The burst detectors of the same area are placed just below the emulsion chambers and allow the chambers to be timed. The 12 units of the emulsion chambers were developed until July 1969. The 6 events of cascade showers in the emulsion chambers were found to be associated with air showers. From these events the energy of hadrons is determined. Transverse momentum of such high energy hadrons is estimated with respect to the axis of the air showers. No clear evidence for the existence of large transverse momentum of hadrons above 3 GeV/c was found in six events. The results obtained by the burst detectors were also analyzed. The relation of the total number of hadrons ($\geq 1.7 \times 10^{12}$ eV) within distances of 10 m from the core and the shower size is represented by the power law $N^{1.3}$. The integral energy spectrum of hadrons is proportional to $E^{-1.1}$ for the size 10^6 and $E^{-2.2}$ for sizes 10^4 and 10^5. The lateral distributions of hadrons were determined. (auth)

37004 HIGH-ENERGY EVENTS IN EXTENSIVE AIR SHOWERS. Miyake, S.; Hinotani, K.; Ito, N.; (and others) (Osaka City Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 463-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Local high-energy events in the core region of EAS, which contain energies of $\approx 10^{12}$ eV or more in a small region of a few tens of centimeters diameter were studied using scintillators covering 12 m^2 above and below a water tank, and were also studied by a multiplate cloud chamber at mountain altitude of 2770 m a.s.l. The results obtained from an analysis of these data are summarized below: the energy spectrum of such events has a knee at about 500 GeV where the negative exponent of the integral spectrum changes from 1.0 to 1.8. The lateral distribution can be expressed as $A \exp(-r/r_0)$, where r_0 has a value of 1-2 m depending on the energy of the event. For a fixed value of energy, A and r_0 increase with the size N_e of the EAS. A decreases while r_0 increases with the age parameters s. As a whole, the total number of events decreases with s, and the total number of such events per shower increases with N_e as $N_e^{0.73}$. (auth)

37005 STUDY OF MULTICORES OF EXTENSIVE AIR SHOWERS. Miyake, S.; Hinotani, K.; Ito, N.; (and others) (Osaka City Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 471-4(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The structure of the cores of extensive air showers was observed by means of plastic scintillators and a multiplate cloud chamber at an altitude of 2770 m above sea level. Multicore events connected with large transverse momenta in high energy interaction are identified by analyzing the density distribution of EAS particles, the energy-flow distribution through 2 m water, and cloud chamber pictures. It is concluded that the majority of subcores are bundles of gamma rays which might be a tail of electromagnetic cascades produced by π^0 gamma rays of the order of about 10^{12} to 10^{13} eV at a height of about 1 to 2 km. The average value of the estimated transverse momentum comes to several GeV/c for the subcores. On the basis of the considerations presented it is easy to understand why visual detectors have shown a smaller proportion of multicored showers than scintillators have. (auth)

37006 NUCLEAR-INTERACTING COMPONENT OF EXTENSIVE AIR SHOWERS. Hook, J. R.; Maslin, G. C.; Orford, K. J.; Turver, K. E. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 475-80(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An experiment was constructed to measure the densities, momenta and electric charges of nuclear interacting particles in extensive air showers, using an air-gap magnet spectrograph and neutron monitor located in an array of water Čerenkov detectors. The magnet spectrograph is used to estimate the momentum and the electric charge of the incident particle; the neutron monitor identifies those particles which are nuclear-interacting. The momentum spectra of pions and protons will be derived from the recorded deflections of negative and positive charged nuclear interacting particles using assumptions similar to those made by Brooke et al. It is expected, following Bradt and Rappaport, that these spectra will be sensitive to the primary particle mass number. The equipment, which has been operating since February 1969, is described. (auth)

37007 FLUCTUATIONS IN LATERAL DISTRIBUTION OF EAS PARTICLE DENSITY. Aseikin, V. S.; Hlavac, T.; Nesterova, N. M.; Cherdyntseva, K. V. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 481-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The lateral distribution of extensive air shower (EAS) particles at an altitude of 3340 m and the fluctuations of this distribution at distances 2 to 20 m from the axis were measured by scintillation counters for EAS with energies $E_0 > 5(10)^{13}$ eV. Multicore events of EAS ($E_0 > 5(10)^{13}$ eV) with distances between cores ≥3 m were analyzed. There was one event ($E_0 > 10^{15}$ eV) in which the shower core struck the scintillation counters, x-ray films and ionization calorimeter. To interpret this event, it is necessary to suppose that the transverse momentum of the secondary particles in the interaction is more than 10^{10} eV/c. (auth)

37008 MEASUREMENTS OF LOW-ENERGY NEUTRONS IN EXTENSIVE AIR SHOWERS USING A GIANT NEUTRON MONITOR. Boehm, E.; Fritze, R.; Roose, J. U.; (and others) (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 487-92(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Neutron bursts produced in a giant neutron monitor by low-energy hadrons in EAS were measured. The lateral distribution of hadrons and the mean hadron energy were derived from the neutron burst size spectra. The dependence of the number of hadrons on the shower size is $N_H \sim N^{0.9}$ in the range from 10^4 to 5×10^6. (auth)

37009 PECULIAR SHOWERS DETECTED WITH THE SYDNEY 100-km² ARRAY. Brownlee, R. G.; David, S. A.; Fisher, A. J.; (and others) (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 493-500(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Details of some of the peculiar large air showers detected by the Sydney 100 km² array are given. (auth)

37010 INVESTIGATION OF HIGH TRANSVERSE MOMENTA IN AIR SHOWERS. Bakich, A. M.; McCusker, C. B. A.; Nelson, D.; (and others) (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 501-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The occurrence of high transverse momenta in air showers of primary energy greater than 10^{15} eV was investigated using the Sydney 64 scintillator array. Detailed experiments show that these are not due to instrumental effects or to fluctuations. It is shown that recent results of the Kiel group require large transverse momenta. (auth)

37011 EXPERIMENTAL INVESTIGATIONS OF FLUCTUATIONS IN DEVELOPMENT OF EXTENSIVE AIR SHOWERS. Firkowski, R.; Gawin, J.; Grochalska, B.; (and others) (Univ., Lodz, Poland). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 509-13(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The fluctuations in EAS development were estimated on the basis of the measurements of the N_μ/N_e ratio for two muon energy thresholds (0.5 and 5 GeV). The differences obtained in width of the fluctuations are shown to be in agreement with theoretical predictions. (auth)

37012 DENSITY SPECTRUM OF EXTENSIVE AIR SHOWERS. Hillas, A. M. (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 539-44(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The altitude dependence of the density spectrum of EAS is such that this spectrum can hardly reflect directly the energy spectrum of individual nucleons in the particles of the primary radiation. However, it does require that the mean free path of the incident primary particles responsible for showers of $\gtrsim 10^6$ particles at sea level is considerably less than 80 g cm^{-2}, and that a drastic flattening of shower cores sets in for $N > 7(10)^5$ particles, as reported in direct observations at Sydney. Some other experiments at present contradict the density spectra which are analyzed. (auth)

37013 HIGH-ENERGY MUONS IN LARGE EXTENSIVE AIR SHOWERS. I. EXPERIMENTAL DATA. Machin, A. C.; Orford, K. J.; Pickersgill, D. R.; Turver, K. E. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 579-83(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Data on the densities, momenta and electric charges of about 4000 muons, recorded at core distances greater than 150 m in large showers in over four years continuous operation of the Haverah Park Solid Iron Magnet Spectrograph, are presented. The presence of distant high momentum muons reported at the Calgary Conference is confirmed. The charge ratio of EAS muons of all momenta was found to be 1.00 ± 0.03, with no significant deviation from charge symmetry for muons of prescribed momenta. The experiment using the original spectrograph was now concluded, and a brief description given of an improved instrument. (auth)

37014 MASS COMPOSITION OF PRIMARY COSMIC RAYS ABOVE 10^{13} eV. Thompson, M. G. (Univ. of Durham, Eng.); Turner, M. J. L.; Wolfendale, A. W.; Wdowczyk, J. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 615-20(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Recent experimental data on muons in extensive air showers are analyzed from the standpoint of the information that can be gained concerning the mass composition of the primary particles. The data are drawn from experiments on both near vertical and inclined showers. A summary of a number of other EAS measurements which refer to the primary composition is also given. It is concluded that there is little support for the hypothesis that heavy nuclei predominate above 10^{15} eV; a preferred view is that the majority of the primaries are still protons above this limit. (auth)

37015 HIGH-ENERGY MUONS IN EXTENSIVE AIR SHOWERS. Vernov, S. N.; Khrenov, B. A.; Khristiansen, G. B. (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 627-32 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

At a depth of 40 hg/cm² underground, a spark chamber detector with the area of $\sigma = 4$ m² operated as the part of the large EAS array of the Moscow State University. The experimental results on muon density spectrum, local fluctuations of muon density, groups of muons and groups of locally generated particles are presented. (auth)

37016 DISTRIBUTION IN ARRIVAL TIMES OF MUONS IN EXTENSIVE AIR SHOWERS. Blake, P. R. (Univ. of Nottingham, Eng.); Harris, D. M. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 633-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An appreciable fraction of the muons in large air showers ($N > 10^7$ particles), observed at distances 200 to 500 meters from the shower axis, are found to arrive more than 100 nsec later than the shower front. The distribution of arrival times was studied, and related to production height. (auth)

37017 FURTHER STUDY OF THE MUON COMPONENT OF EXTENSIVE AIR SHOWERS DETECTED AT HAVERAH PARK. Blake, P. R. (Univ. of Nottingham, Eng.); Ferguson, H.; Harris, D. M.; Nash, W. F.; Thomas, D. W. E. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 639-43(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Recent calculations by the University of Durham EAS group show that studies of the arrival time spread of muons within an EAS and their lateral density distribution beyond one kilometer from the shower core can be expected to yield valuable information relating to the composition of the primary cosmic rays in the region of 10^{17} eV. An apparatus is in the process of construction at Haverah Park by the University of Nottingham group to study these parameters in conjunction with the EAS array there. The apparatus consists of a combined stack of flash tubes and liquid scintillator detectors covering an area of 12.5 m². A digital timing system was devised to give ±10 nsec resolution in the time differences between muons in the showers. Part of the apparatus has now been running for some months, and preliminary results relating to the lateral density distribution studies are presented. (auth)

37018 CURVATURE OF THE MUON SHOWER FRONT IN LARGE AIR SHOWERS. Brownlee, R. G.; David, S. A.; Fisher, A. J.; (and others) (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 645-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The curvature of the muon shower front was determined in suitable cases for showers of primary energy greater than 10^{17} eV using the Sydney 100 km² air shower detector. (auth)

37019 MUON STRUCTURE FUNCTION OF VERY LARGE AIR SHOWERS. Brownlee, R. G.; David, S. A.; Fisher, A. J.; (and others) (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 651-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The Sydney 100 km² air shower detector was used to determine empirical structure functions of showers of various primary energies from 10^{17} eV upwards, at zenith angles from 0 to 80° and at distances up to 2 km from the core. (auth)

37020 ANGULAR DISTRIBUTION OF MUONS IN EXTENSIVE AIR SHOWERS. de Beer, J. F.; de Villiers, E. J.; Reinecke,

J. P. L.; Venter, F. A. (Potchefstroom Univ., S. Afr.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 657-60(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Experimental results are presented on the angular distribution of mu-mesons in extensive air showers with sizes in the range 10^6 to 10^7 particles at distances of approximately 200 meters from the core. Some details and results of theoretical calculations in this connection are also presented and compared with the experimental results. The results are consistent with the currently accepted features of nuclear reactions at very high energies. The results also indicate that scattering plays a very important part in this type of experiment. (auth)

37021 LATERAL DISTRIBUTION OF MUONS IN EXTENSIVE AIR SHOWERS. Staubert, R.; Truemper, J.; Wiedecke, L.; (and others) (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 661-4(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The lateral distribution of muons with energy ≥ 2 GeV in air showers with $N = 10^4$ to 10^8 was measured for core distances ranging from 1 to 100 m. The detector employed was the 14 m^2 neon hodoscope of the Kiel array shielded by 800 g/cm^2 of concrete. The lateral distribution was found to be as steep as $r^{-0.85 \pm 0.02}$ down to core distances of the order of 1 m, and the muon density rises with shower size as $N^{0.78 \pm 0.02}$. Both laws are independent of shower size within the limits of error. (auth)

37022 INVESTIGATIONS OF MUON-RICH SHOWERS. Firkowski, R. (Univ., Lodz, Poland); Grochalska, B.; Karakula, S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 665-70 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Properties of showers with an extremely high number of muons and showers selected by muon triggering are discussed. One hundred and twenty showers with an extraordinarily high number of muons with energies above 5 GeV were selected and their sidereal time distribution was constructed. No significant deviation from isotropy was observed. The relation of the muon density spectrum to the primary energy spectrum at energies about 10^{16} eV is discussed on the basis of over a hundred thousand events and using results of theoretical calculations concerning the relation between muon size and primary energy. (auth)

37023 PRELIMINARY RESULTS OF EXPERIMENTS ON THE RELATION BETWEEN HIGH-ENERGY γ RAYS AND AIR-SHOWER CORES. Dake, S. (Kobe Univ., Japan); Hatano, Y.; Hazama, M.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 671-9 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

High energy γ-rays together with EAS cores are observed simultaneously at Mt. Norikura by means of emulsion chambers (ECC), EAS array and spark chambers. The assignment of γ-rays observed in the ECC to EAS is studied, and some of the γ-ray families or γ-rays assigned to the EAS are observed. Two kinds of spectra rE_γ are obtained for the γ-rays, where E_γ is an energy of γ-ray and r is a distance between a γ-ray and one of the two kinds of axes, the family axis and EAS core axis. Both spectra are represented by the exponential form; and the averages of rE_γ are different from each other, from which $\langle p_{t\gamma} \rangle$ are estimated to be 0.2 GeV/c for the family axis and 1.3 GeV/c for the EAS core axis with the height of production being assumed. Some discussions are presented as to the large p_i value from preliminary results. (auth)

37024 VARIATION OF DENSITY OF PENETRATING PARTICLES IN EXTENSIVE AIR SHOWERS AS FUNCTION OF ZENITH ANGLE. Maze, R. (Cosmic Ray Physics Lab., Verrieres le Buisson, France). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 685-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Extensive air showers with electron densities exceeding 26 m^{-2} were selected by means of the apparatus at Verrières le Buisson. The dependence of the density of penetrating particles upon zenith angle was determined on the basis of 20,000 showers recorded. (auth)

37025 DELAYS BETWEEN THE SOFT AND PENETRATING COMPONENTS OF EXTENSIVE AIR SHOWERS. Hochart, J. P. (Cosmic Ray Physics Lab., Verrieres le Buisson, France); Maze, R.; Catz, Ph.; Gawin, J. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 689-93(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A device for measuring delays was used in connection with the Verrières EAS experiment. The delays between the fronts of electrons and penetrating particles were measured for about 5000 showers ($N_e \geq 10^5$). The reconstruction of the energy spectrum of EAS muons on the basis of the experimental delay spectrum suggests the existence of a cut-off in the spectrum below 2 GeV. Additionally it is shown that the delay between penetrating particles and electrons varies with distance from the shower axis. (auth)

37026 DENSITY SPECTRUM OF THE PENETRATING COMPONENT OF EXTENSIVE AIR SHOWERS. Betev, B. (Physical Inst., Sofia); Bogdanova, N.; Stanev, T.; Valas, G. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 695-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The exponent of the muon density spectrum of EAS was determined at the altitude 2925 m a.s.l. on the basis of 16 926 registered showers by means of an apparatus consisting of four hodoscoped GM counter sets located on the corners of an 8 m × 8 m square under 30 cm lead. The corresponding mean number of muons in the showers was $N_\mu \geq 1.2(10)^6$. The method used to analyze the data made it possible to eliminate the falsifying effect of the multiplication in the lead. The value $\gamma = 2.35 \pm 0.05$ was obtained for the exponent of the spectrum. (auth)

37027 MECHANISM OF RADIO-PULSE PRODUCTION. Abrosimov, A. T. (Moscow State Univ.); Allan, H. R.; Clay, R. W.; Jones, J. K.; Neat, K. P. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 705-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The radio pulses emitted by air showers of energy 10^{17} to 10^{18} eV are found to be polarized in directions which, in a majority of cases, are consistent with the radiation being produced by the geomagnetic separation of positive and negative charges in the shower. Measurements at 32 and 44 MHz give essentially the same result: there is no indication of the geomagnetic effect being weaker at the higher frequency. Large background pulses can, not infrequently, be mistaken for genuine radio pulses, and this explains much of the data apparently inconsistent with the geomagnetic mechanism. There remain a few cases of showers with observed radio pulses too large to be dismissed as background, but which nevertheless have a direction of polarization quite inconsistent with a geomagnetic origin. No interpretation of these events can yet be offered. (auth)

37028 PROPERTIES OF RADIO EMISSION OF EXTENSIVE AIR SHOWERS. Prescott, J. R.; Hough, J. H.; Pidcock, J. K. (Univ. of Calgary, Alberta). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 717-23(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Measurements on the radio signals from extensive air showers with the 22-MHz system at Penticton, Canada, confirm the important contribution of the geomagnetic mechanism. For showers of average size 10^6, whose cores fall close to the antenna, the signal strength is found to depend on the relative orientation of the shower axis and the earth's field in the manner predicted by the theory. At Calgary, signals were detected with a single half wave dipole at 3.6 MHz from showers of mean size 5×10^5. Electric field strengths of 1.0 $\mu V\ m^{-1}\ MHz^{-1}$ and 0.3 $\mu V\ m^{-1}\ MHz^{-1}$ are found at 3.6 MHz and 22 MHz respectively for showers of about 10^6 particles, averaged over all zenith angles. An attempt to detect radio emission at 10 MHz with north–south polarization failed to yield signals distinguishable above noise. (auth)

37029 DEPENDENCE OF RADIO-PULSE AMPLITUDE ON AIR-SHOWER PARAMETERS. Allan, H. R. (Imperial Coll. of Science and Tech., London); Clay, R. W.; Jones, J. K. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 725-30(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Information is presented on the frequency spectrum of the air shower radio pulses, on the way the radio pulse amplitude varies with distance from the shower axis, and on its variation with primary energy. (auth)

37030 STUDY OF RADIO EMISSION FROM EXTENSIVE AIR SHOWERS BY MEANS OF A SYSTEM OF HALF-WAVE DIPOLES IN THE COMPLEX ARRAY OF THE MOSCOW STATE UNIVERSITY. Vernov, S. N.; Khristiansen, G. B.; Abrosimov, A. T.; (and others) (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 731-6(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The radio emission from EAS was studied at a frequency of

30 Mc/s by means of a system of single, horizontal, half-wave dipoles at the Moscow State University. Data are presented on a possible polarization and lateral distribution of radio emission in individual showers. (auth)

37031 HIGH-FREQUENCY RADIO PULSES FROM EXTENSIVE AIR SHOWERS. Galli, M.; Palumbo, G. G. C.; Sinigaglia, G. (Univ., Bologna). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 737-42(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Two radio receivers centered at 30 and 408 MHz, each with a bandwidth of 2 MHz were simultaneously triggered by three plastic scintillators. Pulses from showers with energy $\geq 5(10)^{15}$ eV were observed. While no single pulses above noise were seen at 408 MHz, statistical analysis of all traces shows a positive significant increase at the expected position. The 30 MHz system data show that about $^2/_3$ of the traces carry a radio pulse, suggesting that most showers are accompanied by radio emission. (auth)

37032 RADIO SHOWERS AT MT. CHACALTAYA. Hazen, W. E.; Hendel, A. Z.; Smith, H.; Shah, N. J. (Univ. of Michigan, Ann Arbor). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 743-9 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Seven log-periodic antennas were used simultaneously to detect radio pulses from cosmic-ray air showers at 17 200 ft. Previous work on arrival directions was confirmed by inclining one antenna first W and later N. In both cases, most of the radio showers arrived from the direction of the antenna. The arrival directions of the radio showers were determined from radio pulse arrival times, although not so accurately as from particle arrival times. The proportion of detected radio showers increases with shower size and with zenith angle. Pulse heights in contiguous antennas are roughly the same in individual showers, but, in general, pulse heights do not show good correlation with shower size, core distance or zenith angle. (auth)

37033 RADIO—PARTICLE CORRELATION EXPERIMENT ON EXTENSIVE AIR SHOWERS. Baird, G. A.; Lawless, B.; Slevin, P. J. (University Coll., Dublin). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 751-6(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A twofold coincident ratio receiving system at 44 MHz center frequency was used to study radio pulses received at large zenith angles from extensive air showers. A trigger from the coincident radio system interrogated a particle counter and the video output of an independent radio receiver. The preliminary analysis indicates that radio-particle coincidences occur at a rate of 0.04 events/hr above the random expectation. The video waveform of events associated with particles does not differ in a significant manner from the waveform of other groups of events. (auth)

37034 PULSE SHAPE OF THE RADIO EMISSION OF EXTENSIVE AIR SHOWERS. Borshkovskii, I. A.; Volovik, V. D.; Zaloubovski, I. I.; (and others) (Kharkov State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 757-61(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An array to select extensive air showers and observe radio pulses connected with them is described with special emphasis laid on the response of the amplifying system to the input signal. Characteristics of observed EAS radio pulses are described and results of calculations concerning further possibilities of studying EAS characteristics by means of EAS radio pulses are given. (auth)

7035 ELASTIC PHOTOPRODUCTION OF ρ^0 AND ϕ^0 MESONS ROM HYDROGEN. Berger, C.; Mistry, N.; Roberts, L.; Talman, R.; Walstrom, P. (Cornell Univ., Ithaca, N. Y.). Phys. ett.; 39B: No. 5, 659-62(29 May 1972).

Cross sections are presented for the "elastic" processes $\gamma + \to \rho^0 + p$ and $\gamma + p \to \phi^0 + p$ at 8.5 GeV. The inelastic contribu-on to ρ^0 and ϕ^0 photoproduction from hydrogen was eliminated by equiring a proton recoil in coincidence with the pair-spectrom-ter. Detailed mass-fits were made to the rho data using a Söding terference model to obtain the final "elastic" cross sections. uth)

7036 CONVENTIONAL PROCESSES AND THE UNDER-ROUND MUON COMPONENT. Bergamasco, L.; Castagnoli, .; D'Ettorre Piazzoli, B.; Picchi, P. (Laboratorio di Cosmo-eofisica, Turin. Univ., Turin). Lett. Nuovo Cim.; 4: No. 2, 9-42(13 May 1972).

It is examined whether the conventionally known processes can account for the muon component observed in recent experiments at great depth. In particular, the decay muons for the soft pions muoproduced in rock, which either decay during their flight from the roof and walls of the Laboratory to the detector ($\pi \to \mu$) or directly stop in the detector ($\pi \to \mu \to e$), are calculated. A comparison with the experimental result at the M. Blanc station (4270 m w.e.) indicates that the results cannot be fully accounted for by the conventional process. (L.B.S.)

Weak

Refer also to abstracts 36230, 37210, and 37306.

37037 (ANL/HEP–7208(Vol.1), pp 364-8) COUNTER EXPERIMENT TO MEASURE SIGMA BETA DECAY. Hoffman, C. M.; Smith, A. J. S. (Princeton Univ., N. J.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A proposed counter experiment is described to detect the decay $\Sigma \to n + e + \nu$. The Σ^- decay will be observed to measure the form factors to test the predictions of the Cabibbo theory, and the decay $\Sigma^+ \to n + e^+ + \nu$ will be observed to test the $\Delta S = \Delta Q$ rule. (J.F.P.)

37038 (ANL/HEP–7208(Vol.1), pp 369-77) STUDY OF UNPOLARIZED $\Lambda^0 \to p + e^- + \bar{\nu}$ DECAYS IN A "QUASI-BEAM" CONFIGURATION AT THE ZGS. Abrams, R. (Illinois Univ., Chicago); Aronson, S.; Swallow, E. C. (Chicago Univ., Ill.); Schwartz, D. M. (Ohio State Univ., Columbus); Romanowski, T. A. (Argonne National Lab., Ill. Ohio State Univ., Columbus). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A proposed experiment is described for the study of the $\Lambda \to p + e + \nu$ decay using counter and wire chamber techniques. The study is made for the purpose of severely constraining weak interaction theories by making precise comparisons between the parity-violating and parity-conserving correlations in this decay. It appears possible to obtain over 10^4 unpolarized events of this decay in a quasi-beam experiment at the ZGS. (J.F.P.)

37039 (ANL/HEP–7208(Vol.1), pp 378-88) DESIGN STUDY OF A POLARIZED $\Sigma^- \to ne^-\nu$ EXPERIMENT AT THE ZGS. Watson, J. M.; Moffett, D. R.; Engelmann, R.; Mann, A. (Argonne National Lab., Ill.); Pondrom, L. (Wisconsin Univ., Madison); Romanowski, T. A. (Argonne National Lab., Ill. Ohio State Univ., Columbus); Winston, R. (Chicago Univ., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A proposed experiment to test the Cabibbo hypotheses in the polarized $\Sigma^- \to n + e + \nu$ decay is described. The recommendation of this experiment depends on whether a suitable beam can be built and whether the neutron detection is crucial for identification. On the latter point it is believed that an accurate measurement of the electron asymmetry in this decay could be performed without detecting the neutron. (J.F.P.)

37040 SEARCH FOR THE DECAY $K_S^0 \to \pi^+\pi^-\pi^0$. Jones, L. H. (Univ. of Illinois, Urbana); Abashian, A.; Graham, M. F.; (and others). Nuovo Cim.; 9A: No. 2, 151-9(21 May 1972).

An optical spark chamber experiment was performed to search for the decay $K_S^0 \to \pi^+\pi^-\pi^0$. K^0-mesons were produced by 3 GeV/c π^- in the reaction $\pi^- p \to \Lambda K^0$. 99 events with decay times between 0.5 and 6.5 K_S^0 lifetimes were analysed to give x + iy, the ratio of the amplitude $K_S^0 \to \pi^+\pi^-\pi^0$ to the amplitude $K_L^0 \to \pi^+\pi^-\pi^0$. $x = -0.09 \pm 0.19$, $y = 0.56 \pm 0.43$ was obtained. (auth)

37041 TEST OF THE $\Delta S = \Delta Q$ SELECTION RULE IN K_{e3}^0 DECAY. Mantsch, P. M. (Univ. of Illinois, Urbana); Abashian, A.; Graham, M. F.; (and others). Nuovo Cim.; 9A: No. 2, 160-5(21 May 1972).

An optical spark chamber experiment was performed to test the validity of the $\Delta S = \Delta Q$ weak-interaction selection rule for the decay $K^0(\bar{K}^0) \to \pi^\pm e^\pm \nu$. Analysis of the time distribution of 342 decays has given the complex ratio x of the $\Delta S = -\Delta Q$ to $\Delta S = \Delta Q$ amplitudes to be Re $x = -0.13 \pm 0.11$ and Im $x = -0.04 \pm 0.16$, which is consistent with no violation of the $\Delta S = \Delta Q$ rule. (auth)

37042 TEST OF THE $\Delta S = \Delta Q$ SELECTION RULE IN $K_{\mu 3}^0$ DECAY. Graham, M. F. (Univ. of Illinois, Urbana); Abashian, A.; Jones, L. H.; (and others). Nuovo Cim.; 9A: No. 2, 166-72(21 May 1972).

A test of the $\Delta S = \Delta Q$ selection rule in $K_{\mu 3}^0$ decay was performed using optical spark chambers. K^0-mesons were produced by 3GeV/c π^- in the reaction $\pi^- p \to \Lambda K^0$. 100 events with proper decay times between 0.5 and 6.5 K_s^0 lifetimes were analysed to give a ratio of the $\Delta S = -\Delta Q$ to $\Delta S = \Delta Q$ amplitudes Re x′ = 0.04 $0.04^{+0.10(-0.13)}$, Im x′ = $0.12^{+0.17(-0.16)}$. (auth)

37043 MEASUREMENT OF THE RATIO OF THE AXIAL-VECTOR TO THE VECTOR COUPLING IN THE DECAY $\Sigma^- \rightarrow ne^-\bar{\nu}$. Baltay, C.; Feinman, J.; Franzini, P.; Newman, R.; Yeh, N. (Columbia Univ., New York). Phys. Rev., D; 5: No. 7, 1569-74(1 Apr 1972).

From a sample of 393 Σ^- β decays, 63 events were selected in which a proton recoil from a neutron interaction in the chamber is observed. From the measured values of the electron—neutrino angle it is concluded that for the $\Sigma^- \rightarrow ne^-\bar{\nu}$, $|g_A/g_V| = 0.29^{+0.26}_{-0.29}$. This result is obtained from a maximum-likelihood calculation which includes the effect of a well-understood background of 27 ± 6 events contained in our sample. (auth)

37044 FREE-NEUTRON BETA-DECAY HALF-LIFE. Christensen, C. J.; Nielsen, A.; Bahnsen, A.; Brown, W. K.; Rustad, B. M. (Danish Atomic Energy Commission, Roskilde). Phys. Rev., D; 5: No. 7, 1628-40(1 Apr 1972).

The β-decay half-life of the free neutron was measured. Greater accuracy was obtained through the development of a special 4π β spectrometer with a well-defined, source volume and through the use of a new density calibration method with a ^{3}He proportional counter. A clean thermal-neutron beam was developed especially for the measurement. The final result is a half-life of 10.61 ± 0.16 min. The derived value of g_A/g_V is -1.239 ± 0.011. (auth)

37045 CORRECTION FOR LOSS OF CHARGED SIGMA DECAYS IN BUBBLE CHAMBERS. Griselin, J.; Granet, P.; Barloutaud, R. (CEN, Saclay, France). Nucl. Instrum. Methods; 101: No. 2, 253-6(1972).

A method for correcting the scanning biases of $\Sigma^\pm$ hyperons in bubble chambers is presented. The weight applied to each event is parameterized as a function of the momentum and dip of the $\Sigma^\pm$ for various cuts in projected angle and projected length of the decay particle. (auth)

37046 MULTIFERMION INTERACTION. Gershtein, S. S.; Folomeshkin, V. N. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 15: No. 3, 534-40(Mar 1972). (In Russian).

Limits on the multifermion interaction constants were obtained from the experimental data on the cosmic neutrinos and muons. For the unitary energy squared lower limit of the six- and eight-fermion interactions, estimations were obtained $s_6 > (80\ \mathrm{GeV})^2$ and $s_8 > (60\ \mathrm{GeV})^2$. The upper limits of a possible value of the six-fermion neutrino-nucleon interaction cross section at E = 30 and 200 GeV are equal to 10^{-38} and $2(10)^{-35}$ cm^2, respectively. (auth)

37047 DEPOLARIZATION OF NEGATIVE MUONS IN SOLID BODIES. Dzhuraev, A. A.; Evseev, V. S.; Myasishcheva, G. G.; Obukhov, Yu. V.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1424-32(Apr 1972). (In Russian).

The residual polarization of negative muons in solid bodies with zero nuclear spin (metals, semiconductors, insulators) and in the oxygen of a number of oxygen-containing compounds is investigated by the technique of spin precession in a magnetic field. The results cannot be described by the theory of cascade depolarization for an isolated mesic atom in which the dynamics of filling up of the mesic atom shell during de-excitation is not taken into account. In order to explain the observed large values of the residual polarization it is necessary to take into account the interactions between the mesic atoms and ambient medium, the high degree of mesic atom ionization during mesic atom cascading and the paramagnetism of its electron shell. (auth)

37048 ENERGY LOSS OF MUONS IN THE RANGE 2 TO 500 GeV DUE TO NUCLEAR INTERACTIONS. Allkofer, O. C.; Andresen, R. D. (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 19-24(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A study was made of the production of evaporation neutrons in the interaction of high-energy muons with lead nuclei. The experimental results can be explained by the Kessler theory under the assumption of a constant photonuclear cross section above 1 GeV. It could be shown that the nuclear interactions of high-energy cosmic ray muons as neutron, star, and shower production can be described by a joint concept. Using these results the energy loss of muons was determined. (auth)

37049 PRELIMINARY REPORT ON μ-BUNDLE EXPERIMENT 1300 mwe UNDERGROUND. Totsuka, Y.; Suda, T.; Kondo, T.; Watanabe, Y.; Koshiba, M. (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 29: Supp. 4, 47-52(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An experiment on μ-bundles was started in a mine 497 m underground (Kamioka Mine of Mitsui Mining and Smelting Co.). The purpose of this experiment is to observe first the rate of occurrence of μ-bundles as a function of multiplicity and of zenith angle. The lateral distribution of μ's in a μ-bundle is also to be studied. The detector consists of three layers of wide-gap spark chambers covering an area of 3 m × 3 m. Each layer is divided into four separate spark chambers each of 1.5 m × 1.5 m × (5.0 + 5.0) cm. The triggering pulse for the spark chambers is obtained by nine 1 m × 1 m × 5 cm scintillators, appropriately placed. Each scintillator is viewed from above by four 6655 A photomultipliers to ensure the necessary uniformity in light collection over the area of 1 m × 1 m. The underground experimental room is 8 m in diameter and 5 m in height and is specifically shaped and equipped for this experiment. The preliminary results of the first two months run are reported together with a description of the experimental set-up. (auth)

37050 STUDY OF NUCLEAR INTERACTIONS OF MUONS WITH ENERGIES HIGHER THAN A FEW HUNDRED GeV BY MEANS OF A LARGE CALORIMETER. Chin, S. (Osaka City Univ.); Hanayama, Y.; Hara, T.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 59-64(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A large calorimeter with a volume of 2 m × 2 m × 4.5 m was constructed at a depth of 40 m w.e. underground to study the nuclear interactions by muons with a view to investigating possible evidence for their cross section being larger in the high energy region (>300 GeV) than that predicted from experimental results in the low energy region. The apparatus consists of scintillation counters to measure the total energy transferred to a shower by muons and spark chambers to distinguish nuclear interactions from other events such as electromagnetic processes. (auth)

37051 MULTIPLICITY OF NEUTRONS PRODUCED BY μ CAPTURE. Bobodyanov, I. (Physical-Technical Inst., Dushanbe, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 151-2(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

On the basis of the measured neutron multiplicities ν, due to muon capture in Fe, Cu, Zn, Sb, and Pb, the empirical dependence of ν upon A, the atomic number of the nucleus, was found to be $\nu = (0.30 \pm 0.02)\ A^{1/3}$. (auth)

37052 OBSERVATION OF EXTREMELY HIGH-ENERGY MUON INTERACTIONS WITH AN EMULSION CHAMBER. Misaki, A. (Saitama Univ., Urawa, Japan); Mizutani, K.; Ogata, T.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 157-65(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Showers induced by high energy cosmic ray muons were observed at a depth of 5 m below ground with an emulsion chamber. In the energy region above 1 TeV the energy spectrum of showers was obtained instead of the size spectrum of bursts. In addition to the results, some possibilities for the observation of nuclear interactions of muons were examined. (auth)

37053 ANOMALOUS INTERACTIONS OF MUONS AT VERY HIGH ENERGIES. Mizutani, K.; Mori, K. (Saitama Univ., Urawa, Japan). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 175-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The anomalous interactions of muons at very high energies are studied on the basis of recent data on the zenith angle distribution of muons at sea level and the data obtained at Kolar Gold Fields. (auth)

37054 MUON-INDUCED SHOWERS AT LARGE ZENITH ANGLES. Alexander, D.; Thompson, M. G.; Turner, M. J. L.; Wolfendale, A. W. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 215-20(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Electron showers incident on the large-angle EAS detector at Durham at a mean angle of 73° were studied. The data are examined in terms of muon interactions in the atmosphere and it is found that for sizes above a few hundred particles there is an excess of events similar in magnitude to that detected by Matano et al. The excess is too great to be accounted for by inelastic muon interactions and its origin is not yet understood. (auth)

37055 MULTIPLE PENETRATING PARTICLES OBSERVED AT SEVERAL DEPTH UNDERGROUND IN THE KOLAR GOLD MINES. Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 227-32 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An experiment to study the various characteristics of atmospheric muons underground was completed at two shallow depths, 754 hg/cm^2 and 1500 hg/cm^2 (Kolar) and is currently in operation at a depth of 3375 hg/cm^2 (Kolar) in the Kolar Gold Mines in South India. An analysis of events involving multiple penetrating particles is presented. Events involving multiple penetrating particles are classified into two categories: rock showers produced by the nuclear interactions of muons in the surrounding rock; and multiple muons that are parallel to each other within the accuracy of angular measurement. From the rate of occurrence of rock showers, the cross section for the nuclear interaction of muons was derived. From this, it is estimated that the photonuclear cross section is $\sim 10^{-28}$ cm^2 nucleon and is constant over a wide range of energies above 1 GeV. The angular distribution for double parallel muons was obtained. This closely resembles that for single muons. This suggests that single muons and multiple muons arise in a similar manner. The frequency distribution of double parallel muons was obtained for various values of the separation between them. This, when converted into a decoherence curve, shows a flat distribution over the range of distances from 0 to 2 m, indicating that there is very little local production of muons. (auth)

37056 LATERAL DISTRIBUTION OF ELECTRON–PHOTON CASCADES IN ROCK. Barton, J. C.; Munas, A. F.; Rogers, I. W. (Northern Polytechnic, London). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 253-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A 7.6-cm-diameter 3.8-cm-thick caesium iodide scintillator was operated with pulse shape discrimination to detect nuclear interactions. The total measured rate was 0.51 ± 0.05 g^{-1} day^{-1} at sea level and $0.97 \pm 0.15 \times 10^{-3}$ g^{-1} day^{-1} at a depth of 60 hg/cm^{-2}. Of the 50 events recorded in the underground experiment 30 were identified as being directly produced by muons; the resulting cross section for events of energy greater than 60 MeV was 13 ± 3 μb nucleon^{-1}. The problems of estimating the energy transferred to the nucleus and the secondary energy spectrum are discussed. (auth)

37057 NUCLEAR INTERACTIONS IN CAESIUM IODIDE PRODUCED BY COSMIC-RAY MUONS UNDERGROUND. Barton, J. C.; Parsons, A. J. (Northern Polytechnic, London). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 247-52(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Cascades secondary to cosmic ray muons are being studied as they emerge from the rock into the Holborn underground laboratory (60 hg/cm^{-2}). The apparatus consists of a matrix of 16 liquid scintillation counters, each 7.6 cm^2, surrounded by four larger counters. Pulse height information from all the counters is used to study the lateral distribution of energy. A particle number spectrum is also obtained and the influence of shower selection criteria discussed. (auth)

37058 STUDY OF THE PRODUCTION OF MUON PAIRS BY MUONS. Barton, J. C.; Rogers, I. W. (Northern Polytechnic, London). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 259-62 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A stack of scintillation counters was operated at a depth of 60 hg/cm^{-2} in an attempt to study this process. The number of events observed corresponded to an upper limit for the cross section of 0.4 μb nucleon^{-1} in lead. However, these events could also certainly be due to several interfering processes, so that no lower limit can be set and there is no disagreement with the smaller value that is predicted theoretically. This result conflicts with that of Morris and Stenerson, who reported an anomalously high value. (auth)

37059 INVESTIGATION OF NUCLEAR INTERACTION OF MUONS AT DEPTH OF 316 mwe UNDERGROUND. Bezrukov, L. B.; Beresnev, V. I.; Nyunin, M. I.; Ryazhskaya, O. G.; Zatsepin, G. T. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 285-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Nuclear interaction of muons was studied by means of scintillation counters detecting the size of the showers and neutrons produced in the showers. Nuclear and electromagnetic showers can be separated. The spectrum of nuclear showers was obtained for the energy range from 10^{10} to $2(10)^{11}$ eV. The experimental results in this energy range can be explained in terms of the Hand theory under the assumption of a constant photonuclear cross section $\sigma_\gamma = (1.1 \pm 0.2) \cdot 10^{-28}$ cm^2 per nucleon. (auth)

37060 MUON PHOTONUCLEAR INTERACTIONS. Haywood, J. K.; Bull, R. M.; Nash, W. F. (Univ. of Nottingham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 291-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Pion production by cosmic ray muons was studied using a multiplate cloud chamber in conjunction with the Nottingham muon momentum spectrometer. During a sensitive time of 7511 hours ten events were observed to be initiated by muons in the energy range 3 to 50 GeV. The distributions of energy transfer, and squared four momentum transfer are well explained in terms of the cross section for real photons and a virtual photon spectrum based on the considerations of Daiyasu et al. The distributions of secondary particle momentum and emission angle are interpreted as indicating resonance production. (auth)

37061 MUONIC TRIDENT PRODUCTION BY COSMIC-RAY MUONS. Kelner, S. R.; Kotov, Yu. D.; Logunov, V. M. (Moscow Engineering Physics Inst.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 299-305(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The cross section of production of muon groups via the electromagnetic interaction was calculated. The results obtained are compared with experimental data. (auth)

37062 HIGH-ENERGY NEUTRINOS IN THE UTAH APPARATUS. Hendricks, M. B.; Bergeson, H. E.; Coats, R. B.; (and others) (Univ. of Utah, Salt Lake City). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 313-18(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

In about 5000 m^2 sr days, 2 neutrino events were observed in the Utah detector. Redundant information obtained concerning the muons involved indicates that, with a very high probability, both were moving upward. The rate is consistent with other underground experiments, but one of the muons has the surprisingly high energy of more than 45 GeV and probably more than 100 GeV. (auth)

37063 KOLAR GOLD FIELD NEUTRINO EXPERIMENT: PROGRESS REPORT. Krishnaswamy, M. R. (Tata Inst. of Fundamental Research, Bombay); Menon, M. G. K.; Narasimham, V. S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 319-25(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The latest results from the Kolar Gold Field neutrino experiment are presented. Unambiguous examples of upward moving muon secondaries are reported and measurements made on the momenta of some of the secondaries are described. A comparatively high frequency of multiple particle events was observed, pointing to the importance of inelastic neutrino interactions and suggesting a continuing increase in the inelastic cross section beyond 10 GeV. (auth)

37064 DEEP UNDERGROUND MEASUREMENTS OF COSMIC-RAY MUONS AND NEUTRINOS. Crouch, M. F. (Case Western Reserve Univ., Cleveland); Gurr, H. S.; Kropp, W. R.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 327-31(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Analysis of measurements of cosmic ray muons and neutrinos with the Case–Wits–Irvine deep underground scintillation detector array is nearing completion. In 34 months running time with the 180 m^2 array over 400 events were recorded. Among these 36 had near horizontal trajectories in the solid angle aperture for which there results a characteristic signal interpreted as neutrino interaction secondaries. These events correspond to an isotropic flux of neutrino induced muons of $3.7 \pm 0.6 \times 10^{-9}$ m^{-2} sec^{-1} sr^{-1} of which $0.5 \pm 1.0 \times 10^{-9}$ m^{-2} sec^{-1} sr^{-1} represents the rate attributable to the possible increase in the neutrino interaction cross section in the region above 10 GeV over the value measured at 10 GeV in accelerator experiments. Other data are used to determine the vertical intensity of muons at a depth of 8.82×10^5 g cm^{-2} of standard rock as $2.0 \pm 0.3 \times 10^{-11}$ cm^{-2} sec^{-1} sr^{-1}. A new underground array using a Conversi–Guzzini hodoscope with 48,384 neon flash tubes was 95% completed, and events were observed showing both horizontal and vertical muons. Thus far the combined effects of temperature and humidity on system efficiency have made it difficult to determine absolute rates, and corrective measures are being pursued. (auth)

37065 APPARATUS FOR SIMULTANEOUS MEASUREMENT OF THE ENERGY AND INTERACTIONS OF 1- TO 5-TeV COSMIC-RAY MUONS. Moe, M. K.; Lathrop, J.; Reines, F. (Univ. of California, Irvine). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 333-6(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A horizontal muon spectrometer with a maximum detectable momentum of 15 TeV/c is being constructed with an adjacent 10-m thick burst detector made up of interleaved vertical target plates (initially lead) and proportional counters. The aperture for muons traversing both the burst detector and the spectrometer is 1100 cm^2 sr. (auth)

37066 STUDIES OF NEUTRINO INTERACTIONS AT THE CERN PROTON SYNCHROTRON. Pattison, J. B. M. (CERN, Geneva). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 337-45 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A status report on the analysis of neutrino interactions in propane from the recent experiment at CERN is presented. The CERN Heavy Liquid Bubble Chamber with a propane filling was exposed at the CERN-PS for 1.08×10^6 pulses, corresponding to 6.8×10^{17} protons of momentum 20.6 GeV/c on the target of the improved neutrino beam. The neutrino spectrum was determined indirectly by measuring the muon flux distribution in the neutrino shielding and is considered to be accurate to $\pm15\%$ in the neutrino energy range 1 to 4 GeV. The results of the analysis of the energy and angular distributions of the secondaries emerging from elastic and inelastic neutrino interactions in propane are presented. The variation of particle multiplicity with increasing neutrino energy is discussed and the differential and total cross sections are given. Finally a short summary of the plans for neutrino experiments with the new large (10 m^3) heavy liquid bubble chamber "Gargamelle" is given. (auth)

37067 BACKGROUND EFFECTS IN LOW-ENERGY NEUTRINO EXPERIMENTS. Ashton, F.; Edwards, H. J.; Kelly, G. N. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 347-51(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Stimulated by the experimental work of Cowan et al. an experiment was performed in which neutral primaries produce a single secondary charged particle in a target which subsequently leaves the detector without interaction. The experiments were performed at sea level and the main background effects to possible neutrino interactions are $n + p \rightarrow n + n + \pi^+$ and the charge exchange reaction $n + p \rightarrow p + n$. The measured rate of events is found to be about a factor of two too large assuming only the above processes contribute. Rather than attribute the excess to neutrino interactions it is believed that the neutron flux at sea level is greater than the value assumed. An identical experiment performed underground at a moderate depth (~20 MW(e)) is required to decide whether there is a contribution from neutrino interactions. (auth)

37068 POSSIBILITY OF OBSERVING NEUTRINOS FROM COLLAPSING STARS AND NEUTRINO OSCILLATIONS. Domogatskii, G. V.; Zatsepin, G. T. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 361-5 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

It is shown that there is a possibility of observing neutrinos from gravitational collapses of massive stars in our Galaxy by means of a detector containing some hundred tons of an organic scintillator (for example paraffin oil). In addition to the astrophysical importance of such an investigation it is possible to check the hypothesis on neutrino oscillations put forward by Pontecorvo and to establish a new upper limit for the neutrino mass. (auth)

37069 LOWER LIMIT ON MASS OF THE WEAK INTERMEDIATE BOSON. Cowsik, R.; Pal, Y. (Tata Inst. of Fundamental Research, Bombay). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 367-70(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

It is shown that the observed counting rate of cosmic ray neutrino experiments can be more than accounted for in terms of contributions from neutrinos of energy less than a few tens of GeV using the experimentally measured, nonboson-producing, elastic and inelastic cross section measured in accelerator laboratories. In this way one obtains an upper limit of $0.8 \times 10^{-13}/cm^2$ sec sr, at a 99% confidence level, for the flux of muons contributed by the W-boson production processes, in deep mine neutrino experiments. This suggests a boson mass greater than 7 GeV/c^2. If the product of the W-boson production cross section and the high-energy neutrino flux is uncertain by a factor as large as 4, one still obtains a lower limit of 5.5 GeV/c^2 for the mass of the intermediate boson. This limit is independent of the value of the anomalous magnetic moment and the decay modes of the boson. (auth)

Strong (Baryon-induced)

Refer also to abstracts 36680, 37145, 37239, 37241, 37288, and 37411.

37070 (ANL/HEP-7208(Vol.1), pp 213-47) HADRON NUCLEUS INTERACTIONS: AN EXPERIMENTAL SURVEY. Lubatti, H. J. (Washington Univ., Seattle. Visual Techniques Lab.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A cursory review of some of the experimental data on hadron reactions with nuclei is given. Diffraction dissociation, coherent production with exchange of quant numbers, and some new techniques for studying coherent nuclear production are covered. (J.F.P.)

37071 (ANL/HEP-7208(Vol.1), pp 252-5) BROOKHAVEN HADRON-NUCLEUS SCATTERING EXPERIMENTS. Green, Daniel (State Univ. of New York, Stony Brook). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Preliminary results are reported for the elastic scattering of pions and protons at 19.2 and 10 GeV/c in carbon, aluminum, copper, lead, and uranium. The total cross sections and angular distributions for the scattering of 19.3- and 10-GeV protons on lead are shown allowing one to examine the hadronic matter distribution. The scattering of π^+, π^-, and protons at 10 GeV/c from lead shows different structure. The t-dependence of the elastic differential cross sections for pion scattering by all the above nuclei at 10 GeV/c is shown. (J.F.P.)

37072 (ANL/HEP-7208(Vol.2), pp 604-19) HEAVY MESON SEARCHES IN $\bar{p}p$ ANNIHILATIONS INTO PIONS AND KAONS. Chapman, J. (Michigan Univ., Ann Arbor). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The review is limited to four- and five-body annihilations at 1.0 to 2.6 GeV/c. It is noted that for production of heavy mesons via $\bar{p} + p$ annihilations implies $I = 0$, zero strangeness, and that the mesons are nonexotic. Some $\bar{p} + n$ information is also included if it relates to a reported enhancement. The production and properties of these resonances are discussed. (J.F.P.)

37073 (ANL/HEP-7208(Vol.2), pp 620-47) HIGH MASS-LOW SPIN MESON RESONANCE SPECTROSCOPY USING $\bar{N}N$ REACTIONS. Cline, David (Wisconsin Univ., [Madison]). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

It is pointed out that existing data on $\bar{N}N$ scattering at low energies indicate that the leading boson trajectories are not appreciably excited in the direct channel. However, there is growing evidence for direct channel states on secondary and lower trajectories. The use of $\bar{B}B$ scattering to study new kinds of resonance states not previously observed at low mass as well as exotic boson states is discussed. (auth)

37074 (ANL/HEP-7208(Vol.3), pp 1013-24) EXPERIMENTS WITH $\bar{p},\bar{n}$ BELOW 1 GeV/c. Kalogeropoulos, T. (Syracuse Univ., N. Y.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A number of problems involving antinucleons in the low energy region ($\lesssim$1 GeV/c) which have either been neglected or have been looked at within the traditional framework are discussed. Those problems which might be relevant for further studies in larger chambers ($\gtrsim$7′) are emphasized. (L.B.S.)

37075 (ANL/HEP-7208(Vol.3), pp 1124-39) HIGH ENERGY PHYSICS WITH POLARIZED PROTON BEAMS. Berger, Edmond L. (Argonne National Lab., Ill.); Fox, Geoffrey. 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Areas of high-energy physics in which significant new information can be obtained from experiments with polarized proton beams are explored. It is shown that a broad range of interesting experiments may be carried out for both elastic and inelastic processes. (4 figures) (auth)

37076 (BNL–16797) SMALL ANGLE ELASTIC SCATTERING IN THE ISA. Foley, K. J.; Ozaki, S. (Brookhaven National Lab., Upton, N. Y.). 16 Aug 1971. 7p. Dep. NTIS.

It is shown that measurements of p + p diffraction scattering can be made at ISA with relatively simple experimental arrangements to a precision equal to that obtained with conventional machines of lower energy. The measurements should extend into the region of nuclear Coulomb interference so that a separate determination of the absolute differential elastic cross section can be used for the determination of the phase and magnitude of the forward scattering amplitude. (J.F.P.)

37077 PRODUCTION OF LOW-ENERGY MUONS BY NEUTRAL COMPONENTS OF COSMIC RADIATION. Cowan, C. L.; Talbott, F. L.; Hesse, P. W.; (and others) (Catholic Univ. of America, Washington, D. C.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 107-19(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The investigation of reactions at sea level produced by neutral components of the cosmic radiation which result in at least one muon of either sign and with energy lying between a few tens and a few hundreds of MeV has been undertaken for sometime. Reactions produced by incident neutrons (via pion production and decay) and by gamma radiation are observed and measured in the course of the work. A component of the total production process was observed which seems to be inconsistent with either the neutron or gamma production mode. It is, apparently, strongly correlated with sidereal time and goes via the single negative muon channel only. The value of incident flux times cross section per target nucleon is about 3×10^{-33} per second per steradian. The charge ratio μ^-/μ^+ of the muons produced is about $1.15^{+1.72}_{-0.75}$ for a 50% confidence interval obtained from 76 events collected in 2475 hours of run time and where these 76 events include single negative pion production and in-flight decay events as well. The products of reactions produced by neutral components in the cosmic radiation at sea level were objects of study by the group for some time. Large scintillation systems were the bases of instrumentation in this program until a combined scintillation system-horizontal plate spark chamber was put into operation in the spring of 1966. (auth)

37078 STUDIES OF HADRON INTERACTIONS AT ENERGIES AROUND 10 TeV USING AN IONIZATION SPECTROMETER–EMULSION CHAMBER COMBINATION. Coxell, H.; Gillespie, C. R.; Huggett, R. W. (Louisiana State Univ., Baton Rouge). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 497-503(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

This is a progress report on an experiment which is underway to study the properties of gamma rays emitted from individual interactions of known ultra high energy (~10 TeV). This experiment is being carried out at an altitude of 3.7 km (660 g/cm^2) in the Louisiana State University Cosmic Ray Laboratory located near Climax, Colorado. An emulsion chamber of unique design is used to determine the energies and spatial relations of gamma rays emitted in the decay of π^0 mesons originating from individual interactions of ultra high energy hadrons in a carbon target located above the emulsion chamber. The total energy of an event is determined using an ionization spectrometer having a low-Z (glass) absorber which is about 11-interaction mean free paths deep. Ionization within the spectrometer is sampled every 2 radiation lengths by layers of plastic scintillator which are viewed by photomultipliers. Space and energy resolution within the spectrometer are achieved by using image intensifier cameras that give right-angle stereoscopic photographs of high energy cascades passing through the layers of scintillator. Time resolution with the emulsion chamber is achieved by pulsing the image intensifier cameras as well as neon flash tube hodoscopes when the ionization energy loss within the spectrometer exceeds a hreshold value. Soon after the events of interest have occurred, emulsions containing the events are removed for processing and analysis. (auth)

37079 PRODUCTION OF HYPERNUCLEI BY 1.5 GeV/c K$^-$ MESON INTERACTIONS WITH LIGHT NUCLEI (^{12}C, ^{14}N, ^{16}O) IN NUCLEAR EMULSION. Waheed, A.; Juric, M.; Adamovic, O. (Inst. of Physics, Belgrade). Fizika (Zagreb); 4: No. 2, 87-95 (Apr 1972).

In nuclear emulsion, exposed to 1.5 GeV/c K$^-$ mesons, the interactions on light and heavy nuclei were investigated. Values for the percentage of K$^-$ interactions on light and heavy nuclei, for both track scanned and area scanned stars, have been found to be in agreement with the calculated results obtained from "transparent nucleus" theory. Percentage of the hypernuclei produced on light nuclei is estimated to be 1.1 ± 0.25%. Analysis of parent stars was carried out and mechanism of the formation of hypernuclei is discussed. (auth)

37080 SURVEY OF PRESENT STATUS OF FIREBALLS IN DIFFERENT ENERGY REGIONS. Miesowicz, M. (Inst. of Nuclear Research, Krakow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 9-17(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A brief review is given of the evidences of fireball production and the properties of the fireballs for different energy intervals. (auth)

37081 SEARCH FOR QUARKS IN COSMIC RAYS COMPARED TO CROSS SECTION LIMITS ATTAINABLE USING THE CERN INTERSECTING STORAGE RINGS. Ashton, F.; Kelly, G. N. (Durham Univ., Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 19-24(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The most likely production channels of quarks in high energy nucleon—nucleon collisions are considered and the expected cross section limits attainable in practicable cosmic ray experiments discussed. Particular attention is paid to the mass range accessible above that at the CERN intersecting storage rings. (auth)

37082 OBSERVATION OF EXTREMELY HIGH-ENERGY NUCLEAR INTERACTIONS BY MEANS OF A HUGE EMULSION CHAMBER AT MT. CHACALTAYA. Akashi, M. (Hirosaki Univ., Japan); Watanabe, Z.; Nishikawa, K.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 63-79(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Three huge emulsion chambers were exposed at Mt. Chacaltaya. The energy spectrum, angular distribution and transverse momentum distribution of jets were analyzed. An analysis was made for production of fireballs (H-quanta) and giant fireballs (super H-quanta). (auth)

37083 INVESTIGATION OF 10^{12}-eV INTERACTIONS. Nozaki, T.; Koshiba, M. (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 95-106(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The final results of a systematic investigation of 10^{12}- to 10^{13}-eV interactions in an emulsion block confirm, with considerably increased statistics, the probable existence and the role of the specific baryon state, aleph. An event of still higher energy of nearly 10^{14} eV is analyzed, and it is seen that also at this energy the production and the subsequent decay of aleph presumably occurred. (auth)

37084 INVESTIGATION OF 10^{11}-eV INTERACTIONS. Yamada, S.; Koshiba, M. (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 107-12(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A total of 15 selected interactions in the 100-GeV region were studied by means of a nuclear emulsion stack. There were 76 pions, 4 kaons (possibly 5) and 19 protons (possibly 20) identified in the CMS backward hemisphere. The momentum distribution of each kind of secondary particle was obtained in the CMS. A numerical fit of the pion spectrum is tried for the interaction with $N_h \leq 2$ in the scheme of the pionization-isobar model and a self-consistent interpretation is obtained. The results indicate that in this energy range no detectable role is played by the aleph which was reported as playing the dominant role at thousands of GeV and in still higher energy ranges. The present results on 200 GeV interactions can be understood in terms of ordinary baryon isobars as observed in accelerator experiments plus a group of low energy pions in the CM system pionization. (auth)

37085 NUCLEAR INTERACTIONS IN LIGHT ELEMENTS ABOVE 10^{12}-eV ENERGIES. Gibbs, R. E.; Lord, J. J. (Univ. of Washington, Seattle). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 113-18(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A horizontal-plate emulsion chamber using alternate layers of plastic and emulsion was designed and exposed to the primary cosmic radiation. Proton and alpha particle interactions from heavy primary "break-up" events take place predominantly in the hydrocarbon plates. Average charged particle multiplicities are determined for proton interactions in hydrocarbons: $\langle n_s \rangle$ = 19.2 ± 2.8 at E_p = 1.25 TeV and $\langle n_s \rangle$ = 17.0 ± 2.9 at E_p = 5.7 TeV. The angular distribution of created secondary particles is compared to the theoretical calculations of Hagedorn and Ranft. The average transverse momentum of protons and alpha particles from the primary "break-up" is presented, $\langle P_\perp \rangle_p = 0.45$ GeV/c and $\langle P_\perp \rangle_\alpha = 0.13$ GeV/c per nucleon. Applications of relative multiple scattering of tracks are discussed. (auth)

37086 STUDY OF THE CHARACTERISTIC FEATURES OF COSMIC-RAY JETS OF ENERGY FROM 5 x 10^{10} TO 10^{14} eV IN EMULSION. Curran, A.; Fleming, P.; Imaeda, K.; Kazuno, M. (Inst. for Advanced Studies, Dublin). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 125-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

There were 355 events produced by cosmic-rays with the energy from $5(10)^{10}$ eV to 10^{11} eV, $N_h \leq 5$ and $n_s \geq 5$ analyzed. The dependence of the quantities: multiplicity n_s, and dispersion σ, on the primary energy for the mesonic and nucleonic jets was studied. The empirical relations for the frequency distribution of n_s and σ together with the dependence on primary energy were obtained. It is shown that the average values of n_s and σ for the nucleonic jets are larger than that for the mesonic jets and are increasing with the primary energy up to 10^{14} eV. (auth)

37087 INTERACTIONS OF HIGH-ENERGY (1 TeV) NUCLEONS WITH THE NUCLEI OF PHOTOGRAPHIC EMULSION. Rybicki, K.; Wolter, W. (Inst. of Nuclear Research, Krakow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 143-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An unbiased sample of 54 nucleon interactions produced in the process of fragmentation of four heavy primaries was investigated. The energies of heavy primaries are within the energy interval 0.8 to 1.2 TeV/nucleon. The angular distributions of the particles produced show a bimodal shape with a minimum density of tracks corresponding to 90 degrees in the CM system of colliding nucleons. About 80% of the jets analyzed are symmetrical in the number of tracks emitted forwards and backwards in the CM system of colliding nucleons. The remaining 20% of jets, correlated with the high evaporation of a heavy target nucleus are strongly asymmetric with about 25 additional tracks per jet emitted backwards in the CM system of colliding nucleons. The results presented are consistent with the fireball model and with the model of subsequent collisions of the leading nucleon inside the target nucleus. The high percentage of symmetrical jets among the interactions of nucleons with nuclei of photographic emulsion seems to indicate that the mesons produced in the majority of events do not interact inside the nucleus. This behavior of the pions produced inside the nucleus may be due to the effect of strong collimation of the pions produced, as suggested by Barashenkov, or if one interprets the fireball as a heavy multipion resonance state due to the small value of its cross section. (auth)

37088 IDENTIFICATION OF LOW-ENERGY SECONDARY PARTICLES IN COSMIC-RAY JETS. Babecki, J. (Inst. of Nuclear Research, Krakow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 151-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

In 126 jets fulfilling the conditions: $N_h \leq 5$, $5 \leq n_s \leq 20$, $\gamma_{\mathrm{Cast}} \gtrsim 7$, 59 relativistic particles emitted at angles ≥20° and 85 grey tracks (R > 4000 μm, g* > 1.4) were identified. In 18 jets 2 or 3 protons were found. On this basis it was calculated that in the sample of jets only ≈55% of events correspond to collisions with free or quasi free nucleons. Among $N_g = 0$ events (those without grey tracks) the fraction of interactions with single nucleons is larger, namely ≈70%. A detailed kinematic analysis taking into account the criteria by means of which the particles were selected for identification was carried out. It showed that the value 0.25 for the K/π-ratio for secondary particles must be treated only as a lower limit of this ratio. A low mean value of transverse momentum ≈200 MeV/c was obtained for identified pions. All of them were emitted at very large CM-angles (>165°). (auth)

37089 COMPARISON OF 20-, 60-, AND 200-GeV PION INTERACTIONS IN PHOTOGRAPHIC EMULSION. Gierula, J. (Inst. of Nuclear Research, Krakow); Holynski, R.; Krzywdzinski, S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 157-63(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The characteristics of pion interactions as a function of energy were investigated, using 20-, 60-, and 200-GeV samples. The multiplicity, the shape of the angular distribution of particles produced and its variation with the number of evaporation prongs were compared for these three energy groups. (auth)

37090 COMPARISON OF INELASTIC NUCLEAR INTERACTION CHARACTERISTICS AT 3.5 x 10^{11} eV WITH THOSE OF PION–NUCLEON INTERACTIONS AT 0.6 x 10^{11} eV. Vinitskii, A. Kh.; Eremenko, Yu. A.; Lukin, Yu. T.; Takibaev, Zh. S.; Chasnikov, I. Ya. (Inst. of Nuclear Physics, Alma-Ata, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 165-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The multiplicity and angular distribution of secondary particles produced by cosmic rays of energies between 200 and 500 GeV were compared with the same parameters of secondaries produced in pion-nucleon interactions at an energy of 60 GeV. The multiplicity, $\langle n_s \rangle$, increases with increasing primary energy not faster than $\sim E_0^{1/4}$. The ratio $\langle n_s \rangle / \delta n_s$ is practically independent of the nature and energy of the primary particle. The ratio of the Lorentz factor of the symmetry system and the Lorentz factor of the center of mass system decreases with n_s both for pion-nucleon and nucleon-nucleon interactions. (auth)

37091 ANALYSIS OF NUCLEON–NUCLEON INTERACTIONS AT ACCELERATOR ENERGIES. Boos, E. G.; Pavolva, N. P.; Ruskina, G. Ya.; Takibaev, Zh. S. (Inst. of Nuclear Physics, Alma-Ata, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 169-72(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The multiplicity and the angular distribution of secondary particles in nucleon-nucleon interactions are investigated at accelerator energies. The production probability of events with asymmetric or bimodal angular distributions is estimated. The results are compared with data obtained at cosmic ray energies. (auth)

37092 OBSERVATION OF ≈100-GeV NUCLEAR EVENTS BY MEANS OF A SPARK-EMULSION CHAMBER. Hoshino, K.; Muraki, Y.; Ohashi, Y.; (and others) (Nagoya Univ., Japan). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 189-94(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Jet showers produced by ≈100 GeV cosmic ray nuclear-active particles were observed on Mt. Norikura, 730 g/cm^2. The experiment was made as a preliminary step of a project aiming at a detailed analysis of the jets produced by 0.3 to 3 TeV nuclear-active particles. The apparatus consisted of spark chambers, a spark-emulsion chamber and a calorimeter. The production angles of the charged secondaries were determined in a 10 cm gap spark chamber. The spark-emulsion chamber was used for detection and measurement of the individual gamma-rays of energy ≳15 GeV produced in the jets. The whole apparatus worked satisfactorily. Up to the present time 9 events were analyzed, and a further analysis is in progress. The following were proved: The wide gap spark chamber gave good records of the particle tracks. The gamma-rays from the jets were detected quite efficiently by means of the spark-emulsion chamber. On this basis a new experimental set-up for the higher energy region is now going on. (auth)

37093 RECESSION VELOCITY ANALYSIS OF NUCLEON–NUCLEON INTERACTIONS. Peak, L. S. (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 195-200(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The similarity between nucleon-nucleon interactions occurring at cosmic ray and at machine energies is investigated using the apparent recession of the π mesons in the center of mass system. (auth)

37094 INELASTIC n–p CROSS SECTIONS AT ABOUT 100 AND 130 GeV. Bozoki, G. (Central Research Inst. of Physics, Budapest); Fenyves, E.; Ahababyan, N.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 201-3(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The attenuation of penetrating shower-producing cosmic-ray neutrons in paraffin and carbon is measured with a counter hodoscope arrangement at 2925 m above sea level. The inelastic n–p cross sections are determined by the CH_2-C subtraction method. Results are presented for n–p as well as for n–C cross sections at mean energies of about 100 and 130 GeV. (auth)

37095 PROTON–PROTON INTERACTIONS ABOVE 100 GeV. Jones, L. W. (Univ. of Michigan, Ann Arbor); Bussian, A. E.;

DeMeester, G. D.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 205-10(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

In an experiment at Echo Lake, Colorado, a detector consisting of an ionization calorimeter, spark chambers, and a 2000-liter liquid-hydrogen target was operated to collect over 10^5 triggers corresponding to greater than 80-GeV calorimeter events. Quantities studied include multiplicities, angular distributions, and total inelastic cross sections. Preliminary results give an average multiplicity of secondaries from hydrogen interactions of hadrons about 70% of that from carbon interactions in the 100 to 400 GeV energy range. (auth)

37096 MEASUREMENTS OF THE INELASTIC PROTON–PROTON AND PROTON–CARBON CROSS SECTIONS AT ENERGIES 10^{10} TO 10^{12} eV ON BOARD THE SATELLITES PROTON 1, 2, AND 3. Akimov, V. V.; Grigorov, N. L.; Mamontova, N. A.; (and others) (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 211-14(1970).

From eleventh international conference on cosmic rays, Budapest, Hungary (25 Aug 1969).

The values σ_{pc}^{in} and σ_{pp}^{in} were measured on the satellites Proton 1, 2, and 3 at proton energies of 20 to 600 GeV. The σ_{pc}^{in} increases by 20 ± 5% in this energy range. The σ_{pp}^{in} was measured by means of the difference method using polyethylene and graphite targets. Errors of the σ_{pp}^{in} values were 8 to 20%. An energy dependence of σ_{pp}^{in} similar to that obtained for σ_{pc}^{in} cannot be excluded in the same energy range. (auth)

37097 CHARACTERISTICS OF INELASTIC NUCLEAR INTERACTIONS AT ENERGIES OF 100 TO 500 GeV. Guseva, V. V.; Dobrotin, N. A.; Zelevinskaya, N. G.; (and others) Lebedev Inst. of Physics, Mocow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 219-23(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The interactions of cosmic ray particles with LiH nuclei were recorded by the Tien–Shan apparatus. The analysis is based on 71 interactions with energies of 100 to 500 GeV. Momentum and angular distributions, multiplicity, asymmetry in the CM system and other characteristics are considered for these data. Results of the analysis confirm the picture of interaction which has already been suggested by the authors. (auth)

37098 INELASTICITY IN STRONG INTERACTIONS AT 100 TO 1000 GeV. Akimov, V. N.; Fetisov, I. N.; Slavatinskii, S. A. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 237-41(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The energy transferred to π°-mesons in the interactions of nuclear-active cosmic-ray particles in LiH, Pb and Cu targets was studied with an ionization calorimeter. For the mean values of the energy transferred to neutral pions the following results were obtained: $K^\circ = 0.19 \pm 0.03$ for the interactions in LiH target at $E_0 = 100$ to 500 GeV; for the interactions with the lead and copper nuclei (the fraction of interactions with the lead nuclei is about 70%): $K^\circ = 0.20 \pm 0.03$ at $E_0 = 100 - 300$ GeV, $K^\circ = 0.20 \pm 0.02$ at $E_0 = 300 - 600$ GeV, and $K^\circ = 0.19 \pm 0.03$ at $E_0 = 600 - 1400$ GeV. The K° distributions are also presented. The fraction of events in which large energies are transferred to π°-mesons ($K^\circ > 0.04$) is small (about 10%). (auth)

37099 MEASUREMENT OF THE CROSS SECTION OF INELASTIC NUCLEAR INTERACTIONS AT ENERGIES $\geq 10^{11}$ eV. Vardumyan, D. T.; Marikyan, G. A.; Matevossyan, K. A. (Erevan Physical Inst.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 243-6(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Inelastic interactions of nuclear-active cosmic ray particles of energies higher than 10^{11} eV with lead and aluminum nuclei were investigated by means of spark chambers and an ionization calorimeter at Nor–Hamberd at an altitude of 2050 m a.s.l. The mean free paths for inelastic collisions were found to be 204 ± 36 g cm^{-2} and 102 ± 20 g cm^{-2} in lead and aluminum, respectively. (auth)

37100 REGULARITY OF PARTICLE PRODUCTION IN HIGH-ENERGY COLLISIONS AND ANTINUCLEON–NUCLEON ANNIHILATION. Wang, C. P. (Case Western Reserve Univ., Cleveland). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 247-52(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The regularity of multiplicity distribution reported earlier for charged secondaries emitted from pp, $\pi^\pm$p, pn, $\pi^\pm$n, and nn collisions is found to hold also for K^+p and $\bar{p}$p collisions, and for the neutrals produced in π-p charge-exchange reactions. The 60-GeV/c π-N Serpukhov data are found to follow exactly the parameterless distribution $W_{n_s}^{I}$ obtained previously by the author from the assumption of independent cell structure of the nucleon (and other hadrons and fireball). Despite poor statistics, the distribution fitted well, for the first time, the NN cosmic-ray jet data. For $\bar{N}$N annihilation, the multiplicities are found to follow a corresponding binomial distribution. The significance of this and the structural difference of pion and nucleon above 10^{12} eV are discussed. (auth)

37101 DEPENDENCE OF ENERGY OF ELECTRON–PHOTON CASCADES IN LEAD ON ENERGY OF PRIMARY HADRON. Nikolskii, S. I.; Pavlyuchenko, V. P.; Sokolovskii, V. I; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 259-62(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The investigation of the K_γ values, that is, the fraction of energy passed to the electron-photon cascade in an interaction was carried out by means of an ionization calorimeter with lead absorber. In the energy interval of 0.34 to 6.8 TeV the mean value is $K_\gamma = 0.25 \pm 0.02$. The tendency for K_γ to increase at the end of the energy interval is discussed. (auth)

37102 MOMENTUM SPECTRA OF FAST SECONDARIES FROM PROTON–AIR COLLISIONS DEDUCED FROM ACCELERATOR EXPERIMENTS. Liland, A.; Pilkuhn, H. (Univ., Karlsruhe, Ger.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 293-6 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Differential cross sections $d\sigma/dP$ for the production of $\pi^\pm$, $K^\pm$ and p in 19.2 GeV/c p-air collisions are given, together with prescriptions on their use at higher primary momenta. The fast baryon is found to be 52.5% p, 41.0% n and 6.5% hyperon. (auth)

37103 DIFFERENTIAL CROSS-SECTIONS FOR THE REACTIONS $p + p \rightarrow d + \pi^+$ AND $p + p \rightarrow d + \rho^+$ IN THE ENERGY RANGE FROM 10 TO 24 GeV. Amaldi, U. (Istituto Superiore di Sanita, Rome. Istituto Nazionale di Fisica Nucleare, Rome); Biancastelli, R.; Bosio, C.; (and others). Lett. Nuovo Cim.; 4: No. 4, 121-30(27 May 1972).

Previous high-energy measurements of the differential cross sections for $p + p \rightarrow d + \pi^+$ and $p + p \rightarrow d + \rho^+$ reactions are extended for the energy range 10 to 24 GeV to further study the angular distribution and energy dependence of these processes. In conclusion, the following points are made: (1) The angular distribution of $p + p \rightarrow d + \pi^+$ at high energies may be expressed as an exponential in transverse momentum. The reaction $p + p \rightarrow d + \rho^+$ appears to exhibit a very similar behavior. (2) There is no structure in the angular distributions. (3) The differential cross sections of $d\pi^+$ and $d\rho^+$ compared at $t = 0$ show that while the pion and the rho channels are excited with almost the same cross section at 5 GeV/c the energy dependence of the rho cross section is weaker than that of the pion so that the channel $d\rho^+$ becomes significantly stronger than $d\pi^+$ above 20 GeV/c. (4) Higher-mass states in the region between the A_1 and A_2 are excited with cross sections comparable to those for π^+ and ρ^+. (L.B.S.)

37104 PREDICTION OF ANGULAR DISTRIBUTION OF NEUTRAL PIONS FROM γ-RAY DATA AT ISR ENERGIES. Ganguli, S. N.; Malhotra, P. K. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 39B: No. 5, 632-4(29 May 1972).

The experimental data on the absolute angular distribution of γ-rays from p-p collisions at the ISR were analyzed to deduce angular distribution of the neutral pions and also all created charged particles. The average multiplicity of all created charged particles at $E_{cm} = 44.7$ GeV is estimated to be 9.8 ± 1.5. (auth)

37105 SMALL-ANGLE PROTON–PROTON ELASTIC SCATTERING AT VERY HIGH ENERGIES (460 GeV^2 lt s lt 2900 GeV^2). Barbiellini, G.; Bozzo, M.; Darriulat, P.; (and others) (Technische Hochschule, Aachen. CERN, Geneva. Harvard Univ., Cambridge, Mass. INFN, Genoa. INFN, Turin). Phys. Lett.; 39B: No. 5, 663-7(29 May 1972).

The above processes were investigated at the CERN Intersecting Storage Rings (ISR). Results show a marked change of the slope parameter $b(t,s) = (d/dt) \ln (d\sigma/dt)$ around $-t \approx 0.10$ GeV^2. The s- and t-dependence of b(t,s) were observed over the interval 460 GeV$^2 < s < 2900$ GeV^2 and 0.02 GeV$^2 < t < 0.40$ GeV^2. (auth)

Strong ***(Meson-induced)***

Refer also to abstracts 36200, 36201, 36682, 37227, and 37259.

37106 (ANL/HEP–7208(Vol.1), pp 6-57) RECENT EXPERIMENTAL STUDIES OF THE Kπ INTERACTION. Trippe, Thomas G. (California Univ., Berkeley. Lawrence Radiation Lab.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Recent experimental work on K + π interactions are surveyed. A brief description of the techniques is given, and the compilation, comparison, and interpretation of results and the understanding of discrepancies are discussed. (J.F.P.)

37107 (ANL/HEP–7208(Vol.1), pp 58-91) SOME EXPERIMENTAL RESULTS IN $\pi\pi$ INTERACTIONS, 1969–1971. Gutay, L. J. (Purdue Univ., Lafayette, Ind.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The review of experimental results for $\pi + \pi$ interactions covers the criticisms of various analysis at the Argonne Conference, off-mass-shell dependence and possible narrow structures in the effective mass distribution, forward structure, and an indication of the non-one-pion-exchange production of the high effective mass $\pi\pi$ resonances. (J.F.P.)

37108 (ANL/HEP–7208(Vol.1), pp 104-12) Kπ SCATTERING FOR I = $\frac{3}{2}$ AND $\frac{1}{2}$. Yuta, H. (Argonne National Lab., Ill.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The K + π scattering in the final states of $K^+ + p \rightarrow K^+ + \pi^+ + n$ interactions at 2.53 GeV/c (previously reported) and $K^- + p \rightarrow K^0(K^-) + \pi^-(\pi^+) + p(n)$ interactions at 5.5 GeV/c are studied. The I = $\frac{3}{2}$ p-wave and I = $\frac{1}{2}$ s-wave phase shifts are discussed, and K* production in the K^- interactions is noted. (J.F.P.)

37109 (ANL/HEP–7208(Vol.1), pp 149-50) EXPERIMENTAL REVIEW OF TWO-BODY PROCESSES. Meyer, D. (Michigan Univ., Ann Arbor. Dept. of Physics). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
A categorization table of all fifty-five two-body stable-particle meson-baryon interactions is given. (J.F.P.)

37110 (ANL/HEP–7208(Vol.1), pp 154-6) ELASTIC SCATTERING AT INTERMEDIATE ENERGIES. Brabson, Bennet B. (Indiana Univ., Bloomington. Dept. of Physics). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Future experimental research on elastic $\pi^+ + p$, $\pi^- + p$, and p + p interactions is discussed briefly. Some suggestions are a systematic measurement of differential cross sections out to 90° at 5.5 to 12.5 GeV/c, polarization measurements at 3 to 12.5 GeV/c, depolarization parameter and spin–spin correlation measurements, and a study of the spin-$\frac{1}{2}$–spin-$\frac{1}{2}$ system. (J.F.P.)

37111 (ANL/HEP–7208(Vol.1), pp 157-8) π^-p CHARGE EXCHANGE. Jenkins, T. (Case-Western Reserve Univ., Cleveland, Ohio. Dept. of Physics). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
Present $\pi^- + p$ charge exchange data in existence are summarized in a graph showing the variation of the cos(θ cm) with various momenta. It is suggested that the statistical accuracy and t resolutions of these data over much of the angular range should be improved since they could give a clean test of theoretical models and powerful constraints on these models. It is also suggested that the cross section structure for the reaction $\pi^- + p \rightarrow \eta^0 + n$ should be investigated. (J.F.P.)

37112 (ANL/HEP–7208(Vol.1), pp 159-61) BACKWARD REACTIONS. Eisenstein, B. (Illinois Univ., Urbana. Dept. of Physics). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
A brief review is given for backward strong interactions. A list of parameters for the reaction $\pi^- + p \rightarrow p$ + anything for a future ZGS experiment is given. (J.F.P.)

37113 (ANL/HEP–7208(Vol.1), pp 162-4) K-MESON INTERACTIONS. Russ, J. S. (Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
The interactions of kaons with nucleons are reviewed, and the future directions of research discussed, which can be done at Argonne with little or no advancement in present techniques. (J.F.P.)

37114 (ANL/HEP–7208(Vol.1), pp 165-7) DECUPLET PRODUCTION IN REACTIONS $(0^-)\ (\frac{1}{2}^+) \rightarrow (0^-)(\frac{3}{2}^+)$. Stanfield, K. C. (Michigan Univ., Ann Arbor. Dept. of Physics). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
Decuplet production in the reactions K + N and π + N is reviewed, and proposed future research is discussed. (J.F.P.)

37115 (ANL/HEP–7208(Vol.1), pp 182-5) AMPLITUDE EXPERIMENTS. Kelly, R. L. (Carnegie-Mellon Univ., Pittsburgh, Pa.). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
Some of the more important experiments on π + p interactions which could lead to a determination of the two-body amplitudes are discussed. It is also mentioned that a complete set of measurements on K + p interactions would be of great theoretical interest. (J.F.P.)

37116 (ANL/HEP–7208(Vol.1), pp 186) TWO-BODY REACTIONS AT ZERO DEGREES. Peterson, F. (Iowa State Univ. of Science and Technology, Ames. Dept. of Physics). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
The one pion exchange model with absorption qualitatively explains the forward structure in various $\pi^- + p$ interactions and $n + p \rightarrow p + n$, $\gamma + p \rightarrow \pi^+ + n$ interactions, and the differential cross sections for $K^- + p \rightarrow K(890) + n$ interactions. (J.F.P.)

37117 (ANL/HEP–7208(Vol.2), pp 396-444) STATUS OF THE NON-STRANGE MESON RESONANCES. Garelick, David (Northeastern Univ., Boston, Mass. Dept. of Physics). 1971. (NUB–2103).
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The review of nonstrange meson resonances covers the gross features of the nonstrange boson spectra, the Particle Data Group meson tables, the well established states, low-mass confusion, the R region, the high-mass situation, some nonstandard experimental techniques used in boson spectroscopy, and panoramic views of the boson mass spectrum. (J.F.P.)

37118 (ANL/HEP–7208(Vol. 2), pp 545-91) π EXCHANGE. Fox, Geoffrey (California Inst. of Tech., Pasadena). 1971. (CALT–68-335).
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.
The study of π-exchange processes can be naturally divided into three regions corresponding to $-t \simeq m_\pi^2$, 0.6, and $\gtrsim 1\ (GeV/c)^2$ respectively. In the first (which corresponds to the long-range force with impact parameter $b \gtrsim 1/m_\pi \simeq 1.4$ fm) it is shown that the zero parameter poor man's absorption model is in splendid agreement with experiment. Further the validity of current and future π–π and K–π scattering analyses are discussed. In the second region ($b \simeq 1$ fm), the systematics of single vector meson production ($\pi N \rightarrow (\rho,\omega)N$, $KN \rightarrow K^*N$) are contrasted with those of πN CEX, $\pi N \rightarrow \eta N$, and KN CEX. Better data on $\pi^- p \rightarrow \rho^0 n$ is needed for unambiguous results, but the two sets of data show a pleasing similarity. In the large $-t \gtrsim 1\ (GeV/c)^2$ region ($b \simeq 0 \rightarrow 0.5$ fm), there is a striking similarity around 5 GeV/c between photoproduction and strong interaction π exchange processes. The former—in contrast to the shrinkage of ρ exchange $\pi^- p \rightarrow \pi^0 n$—show a universal $p_{lab}^{-2}\, e^{3t}$ behavior. New strong interaction experiments in both π and ρ (A_2,K**) exchange reactions, for $-t \gtrsim 1\ (GeV/c)^2$ and $p_{lab} \gtrsim 10$ GeV/c are needed to confirm or deny the universality and hence importance of this new component of scattering. (auth)

37119 (ANL/HEP–7208(Vol.2), pp 691-700) PARTIAL WAVE ANALYSIS IN MESON SPECTROSCOPY. Kruse, U. E. (Illinois Univ., Urbana). 1971.
In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A partial wave analysis of the 3π decay modes of the A_1, A_2, and A_3 mesons is made for the interactions $\pi^- + p \rightarrow p + 2\pi^- + \pi^+$ at 5 to 25 GeV/c and $\pi^+ + p \rightarrow p + 2\pi^+ + \pi^-$ at 5 to 8.5 GeV/c. The spins and parities are determined for these resonances. For the A_1 the decay amplitude ratios for $\rho\pi$ and $\epsilon\pi$ are shown, and the polarization and production cross section for the 1^+ state is found. For the A_2 the mass is found and the 2^+ production amplitude is determined. For the A_3 the decay modes of the 2^- state are studied and the enhancement is found almost entirely in the fπ mode. (J.F.P.)

37120 (ANL/HEP–7208(Vol.3), pp 788-99) CASCADE PHYSICS. Smith, Gerald A. (Michigan State Univ., East Lansing). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

An experiment proposed for the 12-ft bubble chamber in which $K^- + p$ interactions would be studied at about 6.5 GeV/c is discussed. The purpose of the experiment is to search for claimed or new Ξ^* states and to measure in a significant way the branching fractions of these states, which are essential from the standpoint of SU(3). Experimental details, scanning and measuring of the pictures obtained, and track analysis and resolution are taken up. (3 figures, 4 tables) (R.W.R.)

37121 (ANL/HEP–7208(Vol.3), pp 814-29) PROPOSAL TO STUDY RESONANCE PRODUCTION IN K^-p AT 6.5 GeV/c. Musgrave, B. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Some of the topics considered in the 12-ft bubble chamber proposal P291 for a high-statistics study of resonance production in K^-p interactions are briefly discussed. Estimated yields and other parameters for production of $S = -2$ resonances, $S = -1$ hyperon resonances, and boson resonances are presented. (L.B.S.)

37122 (ANL/HEP–7208(Vol.3), pp 830-50) K^+p AND K^+d PHYSICS IN THE 12-FOOT BUBBLE CHAMBER. Firestone, Alexander (California Univ., Berkeley. Lawrence Radiation Lab.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Some experimental problems in analyzing K^+p and K^+d interactions at high energies in a large bubble chamber are discussed. Specifically, the discussion is concerned with which final states can be resolved reliably and what the subsequent ambiguities would be like. Three main experiments are discussed: K^+p at 4.6 GeV/c in the LRL 72-inch bubble chamber, K^+p at 9 GeV/c in the BNL 80-inch bubble chamber, and K^+d at 12 GeV/c in the SLAC 82-inch bubble chamber. (L.B.S.)

37123 (ANL/HEP–7208(Vol.3), pp 1025-7) π, K^+ PHYSICS IN THE 2 TO 4 GeV/c RANGE. Gelfand, N. (Chicago Univ., Ill. Enrico Fermi Inst.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

It is pointed out that without improved resolution and/or vastly improved statistics the 12′ bubble chamber offers no improvement over the 82″ chamber for studying resonance production in π and K interactions below 5 GeV/c. It is noted that the 12′ chamber has a potential of finding new phenomena of interest because of the inherent ability to measure precisely the ionization of tracks. (L.B.S.)

37124 (ANL/HEP–7208(Vol.3), pp 1117-21) CHARGE EXCHANGE PROCESSES. Sandler, B. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A partial summary is given of differential cross section and polarization measurements for the processes $\pi^- + p \to \pi^0 + n$ and $\pi^- + p \to \eta^0 + n$. The data are briefly discussed, and indications for future studies at the ZGS are given. (L.B.S.)

37125 SOME ASPECTS OF SINGLE-PARTICLE AND TWO-PARTICLE INCLUSIVE REACTIONS IN 12.7-GeV/c K^+p AND 7-GeV/c π^+p COLLISIONS. Stone, S.; Ferbel, T.; Slattery, P.; Werner, B. (Univ. of Rochester, N. Y.). Phys. Rev., D; 5: No. 7, 1621-7(1 Apr 1972).

Single-particle momentum spectra are presented for π^-, K^0, $\bar{\Lambda}^0$, and Λ^0 particles produced in K^+p collisions at 12.7 GeV/c, and for π^- mesons produced in π^+p collisions at 7 GeV/c. The correlations between the transverse and longitudinal momentum components of these particles are examined and compared to those expected as a result of momentum conservation alone. The transverse-momentum correlations in two-particle inclusive reactions are also investigated and the underlying kinematic constraints on these correlations are discussed. (auth)

37126 INVESTIGATION OF $\pi^- + p \to n + 6\gamma$ REACTION AT 2.94 GeV/c. Novikov, L. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 15: No. 3, 497-9(Mar 1972). (In Russian).

Systems $3\pi^0$ and ($\pi^0\pi^0\eta$, $\eta \to 2\gamma$) were studied in the $\pi^- + p \to n + 6\gamma$ reaction at 2.94 GeV/c. The observed excesses of events over the calculated curves were from the reactions $\pi^-p \to (n\eta, \eta \to 3\pi^0)$ and $\pi^-p \to (n\eta', \eta' \to \pi^0\pi^0\eta, \eta \to 2\gamma)$. Estimations of these reactions cross sections were given. (auth)

37127 PRODUCTION OF FAST NUCLEI OF A = 3 TOGETHER WITH A HYPERNUCLEUS BY 1.5 GeV/c K^- MESONS. Todorovic, Z.; Juric, M. (Inst. of Physics, Belgrade). Fizika (Zagreb); 4: No. 2, 77-85(Apr 1972).

An analysis was made of the production of helium nuclei and tritons of energy greater than 70 MeV in events with a hyperfragment due to 1.5 GeV/c K^- mesons. The results of measurements of the helium nuclei show that the nuclei are predominantly ^{3}He. From the production characteristics of ^{3}He nuclei and tritons it follows that their production mechanisms are the same. It is shown that the nuclei most likely arise from the absorption of secondary π mesons and of the primary K^- meson in ^{4}He-clusters present at the surface of the nucleus. (auth)

37128 GENERAL CHARACTERISTICS OF π^--NUCLEON INTERACTIONS OBTAINED IN NUCLEAR EMULSION AT 45 AND 60 GeV/c. Anzon, E. V. (Inst. of Nuclear Physics, Alma-Ata, USSR); Vinitskii, A. Kh.; Volnov, V. G.; (and others). Acta. Phys. Acad. Sci. Hung.; 29: Suppl. 3, 173-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Several stacks of nuclear emulsion were irradiated by 60 and 45-GeV/c π^--mesons at the Serpukhov accelerator. Interactions with free and quasi-free nucleons were selected. The prong number distribution and the angular distribution of secondary particles were studied and compared with data obtained at lower energies. (auth)

37129 COHERENT PRODUCTION OF PARTICLES ON EMULSION NUCLEI BY 45 AND 60 GeV/c π^- MESONS. Anzon, E. V. (Inst. of Nuclear Physics, Alma-Ata, USSR); Vinitskii, A. Kh.; Volnov, V. G.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 181-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The properties of coherent production in π^- reactions with nuclei at 45 and 60 GeV/c in emulsions are studied. Prong-number distribution, collimation of secondary particles in three-prong stars, five-pion coherent production, and the energy dependence of the coherent cross section are discussed. (J.F.P.)

37130 FEATURES OF THE PION–NUCLEUS INTERACTION AT ENERGIES OF 200 AND 60 GeV. Erofeeva, I. N. (Moscow State Univ.); Mischenko, L. G.; Murzin, V. S.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 225-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The following essential features of pion-nucleus interactions were found in cosmic ray interactions at 200 GeV and with an accelerator at 60 GeV: an asymmetry in the angular distribution which increases with energy (the fraction of asymmetric events is 30% and ≈70% at energies of 60 and 200 GeV, respectively), low multiplicity of asymmetric showers, uniform distribution of the fraction of the energy transferred in photons in the interval from 0 to 1, and a number of other properties. (auth)

37131 MEASUREMENT OF K^{*-} PRODUCTION IN THE REACTION $K^-p \to K^{*-}p$. Blieden, H. R. (State Univ. of New York, Stony Brook); Finocchiaro, G.; Kirz, J.; (and others). Phys. Lett.; 39B: No. 5, 668-70(29 May 1972).

The K^{*-} spectrum in the reaction $K^- + p \to K^{*-} + p$ was measured at beam momenta 10.9, 13.4 and 15.9 GeV/c using the missing mass technique. Production of the L(1770), and a Q-K*(1420) enhancement are observed. Differential cross sections in the range of momentum transfer $0.12 < |t_{pp}| < 0.40$ $(GeV/c)^2$ are given. The L meson is observed with a width $\Gamma = 100 \pm 26$ MeV. The mass spectrum between the L and 2.5 GeV does not show significant structure. (auth)

37132 ENHANCEMENT IN THE $\Lambda\Lambda$ INVARIANT MASS SPECTRUM. Beilliere, P. (Univ. Libre, Brussels); Mayeur, C.; Wilquet, G; (and others). Phys. Lett.; 39B: No. 5, 671-4(29 May 1972).

A 2.1 GeV/c K^- exposure in a heavy liquid bubble chamber was used to search for the final states $K\Lambda\Lambda$. An enhancement in the $\Lambda\Lambda$ invariant mass spectrum at 2370 MeV/c^2 is interpreted as a possible resonance produced in Ξ-nucleon interactions. An estimate of the cross section for $\Lambda\Lambda$ production in Ξ-nucleus relations is given. (auth)

37133 A_1 PRODUCTION IN CHARGE-EXCHANGE REACTIONS. Cohen, D.; Ferbel, T.; Katz, W.; (and others) (Univ. of Rochester, N. Y.). Phys. Rev. Lett.; 28: No. 24, 1601-4 (12 Jun 1972).

The cross section for production of events in the A_1 mass region was measured for two reactions: (1) $\pi^+p \to \pi^+\rho^0p$ and (2) $\pi^-n \to \pi^-\rho^-p$. The results of these experiments, both conducted at an incident pion momentum of ~7 GeV/c, are interpreted within the framework of dual models of inelastic hadron collisions. (auth)

37134 PARTIAL-WAVE ANALYSIS OF $K^-p \rightarrow \pi^\pm\Sigma^\mp$ BETWEEN 1.73 AND 2.11 GeV. Kane, Daniel F. Jr. (Univ. of California, Berkeley). Phys. Rev., D; 5: No. 7, 1583-1602(1 Apr 1972).

Cross-section, angular-distribution, and polarization measurements are presented for 17 energies. Results of a partial-wave analysis based on these data are presented. The presence of resonant structures in the F_{15} and D_{13} waves is confirmed. The masses, widths, and resonant amplitudes are determined: $E_R = 1.925 \pm 0.008$ GeV, $t = -0.137 \pm 0.015$, and $\Gamma = 0.146 \pm 0.022$ GeV for the F_{15}; $E_R = 1.985 \pm 0.005$ GeV, $t = -0.093 \pm 0.006$, $\Gamma = 0.208 \pm 0.022$ GeV for the D_{13}. The D_5 and F_5 octets, F_7 decuplet, and G_7 singlet are studied for SU_3 symmetry of reduced coupling constants; possible conclusions are limited by uncertainty about the detailed energy dependence of the couplings. The D_{13} resonance is shown to be compatible with the D_3 nucleon resonance seen around 2.040 GeV. (auth)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 36203.

37135 (ANL/HEP-7208(Vol.3), pp 851-916) INCLUSIVE EXPERIMENTS: A SECOND GLANCE. Berger, Edmond L. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Recent advances in theoretical and experimental aspects of inclusive reactions are discussed with a view towards suggesting new experiments which will help solidify understanding. After a brief survey of kinematics, the hypotheses of scaling and of limiting fragmentation are discussed and confronted with data. The need for a definitive experiment at NAL energies is acute. Subsequently, emphasis is devoted to Mueller analysis of single-particle inclusive reactions (ab → cX) and to Regge-model predictions for the rate of approach to asymptotic behavior. The success of these predictions is evaluated in terms of available data, and several new experiments in the ANL energy range are suggested in order to test them thoroughly. Analysis is then given of present understanding of shapes of inclusive spectra at fixed energy. Features are described of two-particle inclusive reactions (ab → cd plus anything); particular emphasis is devoted to two-particle correlations. Polarization measurements are proposed in single-particle inclusive reactions. The survey of data and theoretical work is complete through early October, 1971. (18 figures, 2 tables, 54 references) (auth)

General

Refer also to abstracts 36957, 36960, and 37796.

37136 (ANL/HEP-7208(Vol.3), pp 1112-16) SOME PROBLEMS RELATED TO HELICITY CONSERVATION. Salin, Ph. (Bordeaux Univ. (France)). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The following topics are discussed: helicity conservation for diffractive processes; tests of s-channel helicity conservation in photoproduction or A_1 or Q production, and duality and helicity conservation. (L.B.S.)

37137 (ANL/HEP-7208(Vol.3), pp 1147-8) POLARIZATION IN INCLUSIVE REACTIONS. Arnold, R. C. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The information that can be obtained by performing experiments on inclusive interactions with polarization is briefly discussed. (L.B.S.)

37138 (BNL-16801) RESONANCE PHYSICS AT VERY HIGH ENERGIES. Rosner, Jonathan L. (Brookhaven National Lab., Upton, N. Y.). 8 Sep 1971. 38p. Dep. NTIS.

The following topics are discussed: diffraction, rare final states, photon-photon processes, pionization, massive lepton pair production, and possible new types of resonances. (auth)

37139 (BNL-16802) HOW LARGE IS LARGE S? Peierls, R. (Brookhaven National Lab., Upton, N. Y.). 8 Sep 1971. 9p. Dep. NTIS.

The discussion of the magnitude of S includes the relation $F(S/S_0) \gg 1$, where F is some functional form and may involve logarithms, implications of total cross section measurements the rapidity for cross sections for multiparticle final states and cosmic ray and accelerator data, parameters for the determination of S_0, and a large value of S_0. It is concluded that the values of S of the order of $2(10)^5$ are essential to an understanding of the nature of particle production and hadronic collisions. (J.F.P.)

37140 (BNL-16806) EXPERIMENTS WITH COLLIDING BEAMS OF UNEQUAL ENERGIES. von Goeler, E. (Brookhaven National Lab., Upton, N. Y.). Aug 1971. 5p. Dep. NTIS.

Various aspects of experiments with equal beam energies are compared with experiments at unequal energies. The energy in the center of mass, four momentum transfer, solid angle considerations, missing-mass experiments of the type p + p → p + X, and effective-mass experiments are treated. (J.F.P.)

37141 PHYSICAL INTERPRETATION OF THE BALL-PINSKY VARIABLE. Yaes, Robert J. (Johannes Gutenberg-Univ., Mainz). Phys. Rev., D; 5: No. 7, 1873(1 Apr 1972).

It is noted that the new kinematic variable ϕ, proposed by Ball and Pinsky, is just the angle between the 3-momenta of the outgoing particles in the laboratory frame. (auth)

37142 COLLECTIVE CHARACTERISTICS OF MANY PARTICLE SYSTEM. Makhviladze, T. M.; Shelepin, L. A. (Lebedev Inst of Physics, Moscow). Yadern. Fiz.; 15: No. 3, 605-14 (Mar 1972). (In Russian).

A description of coherent properties of boson and fermion systems with a fixed particles number was proposed. The coherent characteristics of such systems was shown to be contained in the present theory and can be determined on the basis of the field operators tensor properties. The Glauber coherent states and partially coherent states were constructed as a superposition of coherent states with fixed particle number. Possibilities of the proposed methods application and their difficulties were considered briefly. It is shown that the correlation between particles in the incident beam can give a considerable increase of the interaction probability. The principal scheme of an experiment where this effect may be revealed is proposed. (auth)

37143 PROGRAM FOR GENERATION OF ARTIFICIAL BUBBLE-CHAMBER EVENTS. Bettels, J.; Dodd, P. (CERN, Geneva). Comput. Phys. Commun.; 3: No. 2, 136-54(Mar 1972).

The computer program GAT written in ASA FORTRAN IV to be used with several computers for the simulation of the output of bubble chamber measurements on particle interactions is described. (J.F.P.)

37144 CONSTANCY OF THE TRANSVERSE MOMENTUM OF SECONDARY PARTICLES IN HIGH- OR ULTRA-HIGH-ENERGY COLLISION. Iida, S.; Muraki, Y. (Nagoya Univ., Japan). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 271-7(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Assuming a "fundamental force," the Schrödinger wave function which characterizes excited bosons is obtained. Decay probability of excited bosons to lower levels is calculated using the wave function and it is shown that the momentum distribution of the emitted mesons obeys the Planck distribution, which is consistent with experiments. The K/π ratio and the multiplicity distribution from the excited bosons are also given assuming SU(3) symmetry. (auth)

37145 TRANSVERSE MOMENTUM OF FIREBALL IN NUCLEAR INTERACTIONS AT ENERGIES OF 100 TO 500 GeV. Zelevinskaya, N. G.; Kotelnikov, K. A.; Maksimenko, V. M.; Slavatinskii, S. A. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 279-83(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The influence of fireball transverse momentum (characterized by the angle θ_0 between the direction of flight of the fireball and that of the primary particle in the L system) on the angular distribution of fireball decay products is investigated. It is shown that with increasing θ_0 the angular distribution in the variable $\lambda = \lg \operatorname{tg} \theta$ narrows and shifts to the right along the λ-axis, the azimuthal asymmetry of the secondaries appears. An attempt to evaluate experimentally the angle θ_0 for 67 interactions of cosmic ray particles with energies E_0 = 100 to 500 GeV (Tien-Shan) led to the upper limit $\theta_0^{max} \approx 2.3°$, which corresponds to an upper limit of the transverse momentum of a fireball $(p_\perp^{FB})^{max} \approx 2$ GeV/c. (auth)

37146 VERIFICATION OF BOUNDARIES FOR THE APPLICATION THEORY TO A SIMPLE TWO-PARTICLE CASE HAVING EXACT SOLUTION. Kamuntavichyus, G. P. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 11: No. 6, 961-6(1971). (In Russian).

The problem of two particles with ½ spin in a common harmonic oscillator potential interacting through harmonic oscillator forces is discussed in the terms of the perturbation theory and compared with the exact solution for the ground state energy. It is shown that perturbation theory expansion for the parameter of two-particle interaction γ coincides with Taylor's series in the region of $\gamma = 0$. If Hartree–Fock approximation is used as a zero order one, the radius of convergence increases twice. It is also shown that if the third-order term is taken into account, it gives worse results compared with those given by the second-order term. (auth)

37147 BILOCAL COMMUTATORS IN THE NONPERTURBATIVE PARTON MODEL. Nash, C. (Cambridge Univ., Eng.). Nuovo Cim.; 9A: No. 3, 300-10(1 Jun 1972).

The commutators of local and bilocal operators are calculated in the nonperturbative parton model; the results obtained agree with those obtained by Gell-Mann and Fritzsch in the free-quark model. (auth)

37148 EIKONAL FORMALISM FOR MULTIPARTICLE PRODUCTION. Calucci, G.; Jengo, R. (Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy). Lett. Nuovo Cim.; 4: No. 2, 33-8(13 May 1972).

A general formalism is presented for describing the multiple production at high energy, which may be considered as a natural extension of the well-known eikonal formalism for elastic scattering. (L.B.S.)

37149 LOWER BOUND OF DIFFERENTIAL CROSS-SECTION DECREASING FOR INCLUSIVE PROCESSES AT HIGH ENERGIES. Logunov, A. A.; Mestvirishvili, M. A. (Inst. of High Energy Physics, Serpukhov, USSR). Teor. Mat. Fiz.; 11: No. 2, 203-5(May 1972). (In Russian).

The lower bound of the decreasing differential cross section for inclusive interactions is established for the region of large scattering angles at $s \to \infty$. (auth)

37150 FINITE-MASS SUM RULES FOR INCLUSIVE REACTIONS. Einhorn, Martin B. (Univ. of California, Berkeley); Ellis, John; Finkelstein, J. Phys. Rev., D; 5: No. 8, 2063-8 (15 Apr 1972).

Taking account of analyticity, crossing, and signature, sum rules relating triple-Regge vertices to integrals over low missing masses in inclusive reactions are derived. Some implications for triple-Regge couplings are discussed. (auth)

37151 INFINITE-MOMENTUM HELICITY STATES. Soper, Davison E. (Princeton Univ., N. J.). Phys. Rev., D; 5: No. 8, 1956-62(15 Apr 1972).

The kind of single-particle spin states which have appeared naturally in field theories in the infinite-momentum frame are discussed and generalized to arbitrary spin. These states transform simply under the Galilean symmetry group, which is important in the infinite-momentum frame, rather than under the rotation group. It is also found that the spinors $U(P,\lambda)$ representing these states are very simple. (auth)

37152 MINIMAL COUPLING AND NONLINEARIZATION OF CHIRAL LAGRANGIAN MODELS. Chen, Min-shih (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 5: No. 8, 2017-20 (15 Apr 1972).

The relationship between the linear models and nonlinear models of chiral symmetry in the presence of electromagnetic interaction is investigated. It is shown that the minimally coupled linear models and the nonlinear models are related by the same nonlinearization procedure as that in the case without electromagnetic interaction. Therefore, any results involving low-energy photons and pions obtained from these models should be uniquely related. (auth)

37153 EFIMOV'S EFFECT: A NEW PATHOLOGY OF THREE-PARTICLE SYSTEMS. II. Amado, R. D. (Univ. of Pennsylvania, Philadelphia); Noble, J. V. Phys. Rev., D; 5: No. 8, 1992-2002 (15 Apr 1972).

By studying the eigenvalue spectrum of the Faddeev kernel in a certain singular limit, an independent proof is given of an effect recently deduced by Efimov: When three identical particles interact via short-range pairwise potentials, the number of three-body bound states grows without limit when the pairwise scattering length a becomes large. [The number of bound states is then roughly $(1/\pi) \ln (\Lambda|\alpha|)$, where Λ is a momentum cutoff.] The proof is extended to the case where only two particles are identical and it is shown that Efimov's effect persists in the special limiting cases with two heavy and one light particle, and with two light and one heavy particle. (auth)

Electromagnetic

Refer also to abstracts 36971, 37326, and 37346.

37154 (BNL–16795) SOME REMARKS ON INELASTIC e-p SCATTERING AT ISABELLE. Orear, Jay (Brookhaven National Lab., Upton, N. Y.). 28 Jul 1971. 5p. Dep. NTIS.

Assuming a 10-GeV electron ring inside the Isabelle tunnel with an e–p colliding beam luminosity of 10^{33} cm^{-2} sec^{-1} over the interacting region, the cross sections and event rate are found for inelastic e + p interactions. (J.F.P.)

37155 (BNL–16796) e-p ELASTIC SCATTERING AT ISABELLE. Orear, Jay (Brookhaven National Lab., Upton, N. Y.). 2 Aug 1971. 3p. Dep. NTIS.

The event rate is estimated for $e + p \to e + p$ interactions in the region of $Q^2 = 2$ GeV^2. A 10-GeV electron ring inside the Isabelle tunnel and an e – p luminosity of 10^{33} cm^{-2} sec^{-1} are assumed. (J.F.P.)

37156 (DESY–72/10) BOUNDS ON DEEP INELASTIC STRUCTURE FUNCTIONS. Pallua, S.; Renner, B. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1972. 22p. Dep. NTIS (U. S. Sales Only).

Bounds on deep inelastic structure functions for virtual photon and neutrino reactions are presented making two assumptions: 1) in the t-channel only nonexotic exchanges are admitted, 2) exotic contributions in the s-channel are due only to an SU_3 singlet in the t-channel, such as the pomeron. Consequences of assuming (1) alone and of assuming (1) and (2) together are listed separately, they include: a bound on the ratio of neutron and proton structure functions $|F_{\gamma N}(\omega)/F_{\gamma p}(\omega)| \geq 1/4$, following from assumption (1) alone, and bounds on the nucleon weak structure functions in terms of supposedly known nucleon electromagnetic structure functions. These bounds are strictly valid only for the weak vector contributions, and they can be used for the axial contributions if these two are asymptotically equal. (auth)

37157 (DESY–72/15) COMPARISON BETWEEN THE BILOCAL ALGEBRA ON THE LIGHT CONE AND THE PARTON MODEL. Chaichian, M. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1972. 10p. Dep. NTIS (U. S. Sales Only).

The bilocal algebra on the light cone is used to obtain the structure functions for the reaction "γ" + nucleon → "γ" + anything, where one or both of the photons are highly virtual and in a special kinematical region of large momentum transfer between the two photons. It predicts a scaling behavior for the structure functions and connects them to the structure functions of the deep inelastic lepton scattering. The impulse approximation of Bjorken and Paschos to the quark parton model gives exactly the same result even when both photons are real. This shows the identity of bilocal algebra and the quark parton model with general distribution functions in the domain where both models are applicable and further either puts some doubt on the validity of parton model when only one or none of the photons is highly virtual or justifies the dominance of the leading light cone singularity for these cases if one assumes the complementarity of the two pictures. (auth)

37158 RIGOROUS BOUND FOR THE $e^+e^- \to \pi^0\gamma$ CROSS SECTION. Palmer, D. R. (Univ. of Rochester, N. Y.). Nuovo Cim.; 9A: No. 2, 212-18(21 May 1972).

Using only the analyticity of the $\gamma\gamma\pi^0$ form factor and the experimental lifetime of the π^0, the bound on an integral over the total cross section for $e^+e^- \to \pi^0\gamma$ is determined. Bounds are also obtained for the isoscalar and isovector cross sections separately. (auth)

37159 LIGHT-CONE EXPANSION FOR VERTEX FUNCTIONS AND EXCLUSIVE PRODUCTION AMPLITUDES. Mueller, V. F.; Ruehl, W. (Univ. Trier, Kaiserslautern, Ger.). Nuovo Cim.; 9A: No. 2, 199-211(21 May 1972).

The matrix element of the electromagnetic current operator between a single-hadron and a single- or two-hadron state is studied in the scaling limit $k^2 \to \infty$. The analysis is based on a light-cone expansion of a regularized retarded commutator of the current with a hadronic field operator. It must be required that the asymptotic expansion for the matrix element be independent of the retardation function. (auth)

37160 LIGHT-CONE ANALYSIS OF SOFT-PION PRODUCTION IN DEEP-INELASTIC ELECTRON–PROTON SCATTERING. Lee, S. Y. (Univ. of California, San Diego, La Jolla). Phys. Rev., D; 5: No. 7, 1729-31(1 Apr 1972).

Partial conservation of axial-vector current and light-cone current commutators in the gluon-quark model are used to study the scaling behavior of one-soft-pion production in deep-inelastic e-p scattering. A very interesting sum rule which relates the inverse square of the pion decay constant to the integral of the scaling functions is obtained, namely $f_\pi^{-2} = \int_0^1 (d\omega/\omega)(F_2^{\pi+} - F_2^{\pi-})$. (auth)

37161 ONE-PION EXCHANGE AND DEEP-INELASTIC ELECTRON–NUCLEON SCATTERING. Sullivan, J. D. (National Accelerator Lab., Batavia, Ill.). Phys. Rev., D; 5: No. 7, 1732-7(1 Apr 1972).

The role of one-pion exchange is examined in the deep-inelastic region for electron-nucleon scattering. Exclusive channels like πN, $\pi\Delta$ will contribute negligible, nonscaling contributions to σ_s. On the other hand, inclusive final states like N + "anything," where the detected final nucleon is slow in the lab system, afford the opportunity to experimentally determine the structure functions for electron-pion scattering provided the characteristic one-pion-exchange structure (dip or peak) is observed at small momentum transfer. (auth)

37162 SCALING PROPERTIES AND THE BOUND-STATE NATURE OF THE PHYSICAL NUCLEON. Drell, S. D. (Stanford Univ., Calif.); Lee, T. D. Phys. Rev., D; 5: No. 7, 1738-63(1 Apr 1972).

The scaling property in deep-inelastic electron scattering is established by regarding the physical nucleon as a bound state of a bare nucleon and a bare meson (or a few bare mesons). This bound-state formulation provides a fully relativistic generalization of the "parton" model that is no longer restricted to infinite-momentum frames. It also connects the scaling property in inelastic processes with the rapid decrease of the electromagnetic form factors in elastic scattering. Rigorous statements are derived for specific bound-state solutions of the Bethe-Salpeter equation with the ladder approximation. An Adler sum rule is derived and crossing properties are discussed. A general phenomenological approach is developed which is relativistically covariant and gauge-invariant, and which allows one to correlate directly the observed structure functions and form factors with the appropriate bound-state wave function. If all constituents in the bound state are assumed to be of masses $\lesssim 1$ GeV, the model gives a qualitative understanding as to why the scaling property is experimentally observed at relatively moderate energies. (auth)

37163 RADIATIVE CORRECTIONS TO THE DECAY $\pi^0 \to \gamma^+e^-$. Mikaelian, K. O.; Smith, J. (State Univ. of New York, Stony Brook). Phys. Rev., D; 5: No. 7, 1763-73(1 Apr 1972).

The radiative corrections to the $\pi^0 \to \gamma e^+e^-$ decay are calculated over the whole range of the Dalitz plot, with no restrictions on the radiative photon energy. The corrections are found to be negative and large in magnitude in the region of large invariant mass of the Dalitz pair, and small but positive for small values of the same quantity. The total correction to the decay rate, defined by $\Gamma^{rad}(\pi^0 \to \gamma e^+e^-)/\Gamma(\pi^0 \to \gamma\gamma)$ is positive and agrees with the results of previous calculations. (auth)

37164 TIME-REVERSAL INVARIANCE AND THE PHASE OF THE $\rho-\omega$ MIXING. Gein, T. T. (Memorial Univ. of Newfoundland, St. John's). Phys. Rev., D; 5: No. 7, 1773-83(1 Apr 1972).

The unitarity sum is used to rederive in a simple way an explicit formula for the $\rho-\omega$ mixing phase in terms of $|\epsilon|$, Γ_ω, Γ_ρ, and $m_\omega^2 - m_\rho^2$. A systematic study of the condition imposed by T (or CPT) invariance and unitarity on the relative phase and strength of the mixing is presented. It is shown that the departure from T invariance in the $\rho-\omega$ system is, in principle, directly demonstrable through the measurement of the $\rho-\omega$ mixing phase in $e^+e^- \to \pi^+\pi^-$. The connection between the phase discrepancy and the breakdown of microscopic reversibility is also discussed. Finally, two possible graphical representations for the $\rho-\omega$ mixing parameters which exhibit directly the condition imposed by unitarity and time-reversal invariance on the relative phases and strengths of the $\rho-\omega$ mixing are given. (auth)

37165 CONTINUATION FROM DEEP ELECTROPRODUCTION TO DEEP ELECTRON–POSITRON ANNIHILATION. Gatto, R. (Univ., Rome); Menotti, P.; Vendramin, I. Lett. Nuovo Cim.; 4: No. 3, 79-86(20 May 1972).

It was previously proposed that the analytic continuation of the scaling function $F(\omega)$ for deep electroproduction gives, under suitable assumptions, the asymptotic scaling function for deep electron-positron annihilation. It is illustrated that the function $F(\omega)$ may possess cuts lying on the real axis of ω, exactly in that region where one has to analytically continue in order to obtain the deep annihilation scaling function. (L.B.S.)

37166 PHENOMENOLOGICAL DESCRIPTION OF OFF-MASS SHELL PARTICLES INTERACTION AMPLITUDES. Dremin, I. M. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 15: No. 3, 582-90(Mar 1972). (In Russian).

A phenomenological formula that describes experimental data on the deep inelastic electron–proton scattering is proposed. It is obtained on the basis of a simplest combination of the threshold behavior ($\omega \to 1$) and of the high energy Regge description of the virtual photon–nucleon scattering amplitude. A generalization of this formula for a case of two virtual colliding particles is given. A possibility of its use in the multiperipheral scheme is discussed. The question of separation of total cross sections on a background and resonance parts by using their different behavior relative to change of the colliding particles is considered. (auth)

37167 ANGLE AND SPACE DISTRIBUTION OF ELECTRON–PHOTON SHOWERS PARTICLES. Guzhavin, V. V.; Ivanenko, I. P.; Kirillov, A. A.; Paskhalov, Yu. I. (Moscow State Univ.). Yadern Fiz.; 15: No. 3, 500-7(Mar 1972). (In Russian).

The showers electrons space distribution functions for various depths t of the electron-photon shower development in the homogeneous atmosphere were calculated by the moments method. The moments calculations were carried out with formulas which take into account an exact t-dependence of the moments. (auth)

37168 LATERAL SPREAD OF NUCLEAR–ELECTROMAGNETIC CASCADES IN IRON. Jones, W. V. (Max-Planck-Institut fuer Physik und Astrophysik, Garching, Ger. Louisiana State Univ., Baton Rouge). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 513-19(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The lateral spreading of nuclear-electromagnetic cascades in an iron absorber was determined by a three-dimensional Monte Carlo simulation of the cascading process. The simulation was fitted at one lateral position for each of three longitudinal depths with measurements made with an iron spectrometer which was exposed to 10-, 20.5-, and 28-GeV protons from an accelerator. The calculations were then extended to higher energies and to larger lateral distances and longitudinal depths. The average number of cascade particles contained within circular rings of radius R (radiation lengths) are given as a function of R at various depths in the absorber over the primary energy range 10 to 1000 GeV. The normal fluctuations of the particles located in these rings are also given. The radii required to contain 90% of the cascade particles are compared with the radii required to contain 90% of the cascade energy. (auth)

37169 DESCRIPTION OF RELATIVISTIC PARTICLES WITH ARBITRARY SPIN IN THE ELECTROMAGNETIC FIELD. Ulrici, Wolfgang O. (Univ., Munich). Z. Naturforsch.; 27a: No. 2, 339-62(Feb 1972). (In German).

Starting with the equations of the center-of-mass motion and spin motion of a particle in a homogeneous electromagnetic field, the Hamiltonian and the wave equation of a relativistic particle with arbitrary spin and arbitrary magnetic moment in this field are derived. A change is made from the canonical representation to spinor representations with convenient transformation properties, and form of the wave equation which, for the special case of spin $^1/_2$, coincides with the Dirac equation (in the form first given by Feynman) is found. The problems and limitations of this derivation are extensively discussed. (auth)

37170 STIMULATED COMPTON INTERACTION BETWEEN MAXWELLIAN ELECTRONS AND SPECTRALLY NARROW RADIATION. Zel'dovich, Ya. B.; Levich, E. V.; Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1392-1408(Apr 1972). (In Russian).

Effects related to stimulated Compton scattering of high intensity radiation by free electrons (electron heating, distortion of the radiation spectrum, stimulated light pressure) diminish with decrease of the spectral width and angular aperture of the radiation. The integral kinetic equation (its nucleus has been found) permits one to determine the electron heating rate and to find an analytic solution of the evolution of intense spectral lines during stimulated Compton interaction for arbitrary spectral widths and angular apertures of the radiation beam. (auth)

37171 RADIATION EMISSION BY ELECTRONS TRAVERSING THIN METALLIC FILMS. Arutyunyan, F. R.; Mkhitaryan, A. Kh.; Ovsepyan, R. O.; Oganesyan, R. A.; Rostomyan, B. O. (Inst. of Physical Research, Erevan). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1263-71(Apr 1972). (In Russian).

The results of an experimental investigation of the radiation emitted in the visible and ultraviolet regions on traversal of 100 keV electrons through thin metallic films (Al, Ag, Au, Cu) are discussed. The spectral and angular distributions of the radiation and also the dependence of its intensity on electron energy, film thickness, angle of electron entrance into the film and optical constants of the substances are investigated. An analysis of the data shows that the distributions completely agree with the Ginzburg–Franck theory of transition radiation. (auth)

37172 PAIR PRODUCTION IN AN ALTERNATING HOMOGENEOUS ELECTRIC FIELD AS AN OSCILLATOR PROBLEM. Popov, V. S. (Inst. of Theoretical and Experimental Physics, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1248-62(Apr 1972). (In Russian).

The calculation of the probability of pair production in a strong spatially homogeneous electric field E(t) reduces to the problem of parametric excitation of a quantum oscillator (or, what is the equivalent, to calculation of the reflection coefficient for a plane wave incident on a one-dimensional potential barrier). Because of this relation the calculation of the pair production probability does not require a knowledge of the exact solutions of the relativisitic wave functions or Green functions. In the particular case when $E(t) = E(\mathrm{ch}\ \omega t)^{-2}$, the probability w is identical to the reflection coefficient for the Eckart potential. The relation between the exact formulas for w and the quasiclassical approximation ("imaginary time" method) is considered in detail and the limits of applicability of the quasiclassical approach are indicated. (auth)

37173 GENERAL FORM OF THE CROSS SECTIONS AND POLARIZATION EFFECTS IN THE ELECTROMAGNETIC AND WEAK PROCESSES. Rekalo, A. P. (Physical-Technical Inst., Moscow). Yadern. Fiz.; 15: No. 3, 541-8(Mar 1972). (In Russian).

Scattering processes with the matrix elements in the form of currents product were considered. General formulas for the cross sections, the angular distribution asymmetry, and the secondary particle polarization were obtained in the invariant functions terms. The formulas do not depend on the particle spin value and take into account possibilities of the current nonconservation and of a C, P and T breaking. Expressions for the invariant functions in the terms of the particle form factors were obtained for 0, $\frac{1}{2}$ and 1 spin values. (auth)

37174 RECOILED NUCLEON POLARIZATION IN THE PION PHOTO- AND ELECTROPRODUCTION. Omelaenko, A. S. (Physical-Technical Inst., Moscow). Yadern. Fiz.; 15: No. 3, 549-52(Mar 1972). (In Russian).

The general formulas for the recoiled nucleon polarization in the single-pion electroproduction on a nucleon were obtained. The different contributions to the polarization of the proton produced in reactions $\gamma p \rightarrow p'\pi^0$, $ep \rightarrow e'p'\pi^0$ were estimated in the first nucleon resonance energy region. (auth)

37175 PERTURBATION OF BOUND STATES OF A DIRAC EQUATION FOR AN ELECTRON IN A CENTRAL-SYMMETRIC FIELD. Sherstyuk, A. I. Zh. Eksp. Teor. Fiz.; 62: No. 4, 1238-47(Apr 1972). (In Russian).

The correction to the wave function in the problem of perturbation of bound states of a Dirac electron in a Coulomb field by an arbitrary central-symmetric potential is represented as an expansion in the complete set of eigenfunctions of the Sturm–Liouville operator which possesses only a discrete spectrum. This approach circumvents summation over continuous energy states with both negative or positive energies. Hence in a number of cases infinite sums of perturbation theory can be represented in a closed form. Finite expressions for first-order corrections to the electron Dirac wave function in the field of a screened Coulomb potential are obtained explicitly. The second- and third-order energies are expressed in terms of one of the components of the first-order wave function. (auth)

37176 ENERGY SPECTRA OF γ QUANTA IN FAMILIES AND THEIR INTERPRETATION. Apanasenko, A. V.; Baradzei, L. T.; Smorodin, Yu. A.; Solov'ev, M. V. (Lebedev Inst. of Physics, Moscow. Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 85-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The exponential approximation of the experimental spectra of γ-rays in a family was tested. The exponent does not change in the energy range 1 to 50 TeV. The exponential spectra of γ-quanta correspond to the case when the π°-mesons are emitted isotropically with a momentum distribution of the Planck type. The mass, temperature, and Lorentz factor of such a cluster are determined. The mass is near to 1 GeV/c^2, kT is near to the pion mass and neither changes with energy. The value of γ_s is close to ΣE_γ measured in GeV. The importance of fluctuation is shown by Monte-Carlo calculation. (auth)

37177 APPLICATION OF THE PERTURBATION METHOD TO STUDY THE TRANSITION EFFECT. Kolchuzhkin, A. M.; Ryzhov, V. V.; Uchaikin, V. V. (Tomsk Polytechnical Inst., USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 333-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A perturbation theory formalism was developed to solve the problem of electromagnetic cascades by means of expanding the Green operator of perturbation into a series corresponding to the successive generations. The formulas were used to investigate the transition effect. (auth)

37178 STRUCTURE FUNCTION AND CORE-LOCATION DETERMINATIONS WITH THE HAVERAH PARK 500-m ARRAY. Andrews, D.; Evans, A. C.; Hollows, J. D.; (and others) (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 49-54(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Seven density samples are now available for the analysis of showers detected by the Haverah Park 500 m array. The power law dependence of the lateral distribution function was investigated using an analysis which differs from that in previous work in the use of extra densities and more rigid selection criteria. Results on eight showers whose core positions are known independent of the analysis are discussed. A distribution of the power law exponent of individual showers is compared with previous analysis and a simulated distribution. Core location uncertainties are discussed. (auth)

37179 DEVELOPMENT OF ELECTROMAGNETIC CASCADES IN STRATIFIED MEDIA. Gerasimova, N. M. (Moscow State Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 515-18(1970).

From 11. international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Radial and angular distributions of electrons and photons were calculated in electromagnetic cascades developing in media consisting of alternating layers of thin and thick materials with different critical energies. (auth)

37180 FLUCTUATION PHENOMENA IN EXTENSIVE AIR SHOWER CORES. Thielheim, K. O.; Beiersdorf, R. (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 519-25(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Results of Monte Carlo simulations of the nuclear active and electromagnetic components of extensive air showers are presented. (auth)

37181 PREDICTED PROPERTIES OF AIR SHOWERS DERIVED FROM MONTE CARLO SIMULATIONS. McCusker, C. B. A.; Peak, L. S.; Rathgeber, M. H. (Univ. of Sydney). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 527-31(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Results for the numbers of electrons and muons at sea level (and fluctuations) are presented for primary protons and copper nuclei in the range of 10^8 to 10^{11} GeV and zenith angles of 0 to 69°. These were obtained from a one-dimensional Monte Carlo simulation using an isobar model. (auth)

37182 CALCULATIONS ON THE PARTICLE AND ENERGY-LOSS DENSITIES IN EXTENSIVE AIR SHOWERS AT LARGE AXIAL DISTANCES. Hillas, A. M.; Hollows, J. D.; Hunter, H. W.; Marsden, D. J. (Univ. of Leeds, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 533-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The apparent particle densities and muon spectra were calculated for distances 100 to 1300 m from the axes of extensive air showers at sea level, for primary energies up to 10^{20} eV, and the results given in a form which can be used to interpret the measurements made with the Haverah Park array. The results suggest that in the region around 400 to 500 m, of particular importance in this array, shower size and muon content vary very little with mass of the primary particle. Most results apply to vertical showers, but muon densities and spectra were also calculated for 25 and 85° zenith angles. (auth)

37183 CALCULATION OF PROPERTIES OF EXTENSIVE AIR SHOWERS FOR DIFFERENT MODELS OF THE ELEMENTARY ACT. Giler, M. (Univ., Lodz, Poland); Karakula, S.; Kempa, J.; (and others) Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 545-53(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Theoretical investigations of various models of EAS development are described and results of numerical calculations are given. The isobar model and the model based on the so-called

CKP formula were taken as basic models. Some modifications of these models were also considered. The main aim of the calculations was to discuss the problem of the primary energy spectrum and the model of EAS development on the basis of properties of the muon and electron components. Some remarks on the nuclear-active and Čerenkov components are given. (auth)

37184 SIMULATION IN SPACE AND TIME OF THE NUCLEAR-ACTIVE AND MUON COMPONENTS IN AIR SHOWERS. PART I. MODELS AND CALCULATIONS. Grieder, P. K. F. (Univ., Bern). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 563-8 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Two basic shower models which follow different high energy multiplicity laws are discussed that have been used extensively for simulating the nuclear active and muon components in air showers in space and time. Both models are derived from a general isobar-fireball model. In one, production of a single fireball, stationary in the c.m.s. is assumed to occur at high energies, while double fireball production with forward-backward motion in the c.m.s. is considered in the other. (auth)

37185 SIMULATION IN SPACE AND TIME OF THE NUCLEAR-ACTIVE AND MUON COMPONENTS IN AIR SHOWERS. PART II. EFFECT OF PARAMETER VARIATION AND RESULTS. Grieder, P. K. F. (Univ., Bern). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 569-77(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The effect of parameter variation on the two models presented previously is discussed. Some typical results are shown for 10^4 and 10^5 GeV proton-initiated showers and are compared with experimental data. (auth)

37186 HIGH-ENERGY MUONS IN LARGE EXTENSIVE AIR SHOWERS. II. MODEL CALCULATIONS. Orford, K. J.; Turver, K. E. (Univ. of Durham, Eng.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 585-91(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Calculations were made for the density of muons far from the cores of large E.A.S. The parameters which influence the density of high momentum muons at large core distances were shown to be the primary cosmic ray mass number, the relation governing the multiplicity of interaction secondaries produced in high energy nucleon-nucleus and pion-nucleus collisions, and their mean transverse momentum. The calculations were made specifically for comparison with the results from the Haverah Park spectrograph and are rigorous for those ranges of momentum and lateral distance concerned. A comparison with the data given by Machin et al. is made, and those models able to predict the observed densities of high momentum distant muons are discussed. (auth)

37187 CASCADE THEORY UNDER APPROXIMATION C. Misaki, A. (Saitama Univ., Urawa, Japan). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 593-600(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A cascade theory is developed under Approximation C. "Approximation C" is called the approximation in which the collision process and Compton effect are considered, and the more precise formula instead of the asymptotic one is used to describe the radiation process and pair production. Analytical expressions are given. (auth)

37188 CHERENKOV LIGHT DISTRIBUTION FROM 10^{11}-eV GAMMA-RAY-INITIATED AIR SHOWERS. Rieke, G. H. (Smithsonian Astrophysical Observatory, Amado, Ariz.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 601-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The lateral, angular, and temporal distributions of the Čerenkov light from 10^{11}-eV gamma-ray-initiated air showers are discussed. The calculations are based on an accurate model of the showers obtained from a Monte Carlo computer program. The lateral and angular distributions of light are consistent with previous estimates; the pulse widths are about 3 nsec, somewhat broader than indicated by other work. Evidence for an annular component of the light is evaluated. (auth)

37189 THEORETICAL ANALYSIS OF EXTENSIVE AIR SHOWERS. Cachon, A.; Capedvielle, J. N.; Dupuy, J. (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 607-8(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The longitudinal and the lateral developments of electromagnetic, muonic and hadronic components are calculated, using various values of the parameters. Comparison with experiments is made. (auth)

37190 LATERAL DENSITY DISTRIBUTION OF MUONS IN EXTENSIVE AIR SHOWERS AT MOUNTAIN LEVEL. Danilova, T. V.; Dedenko, L. G.; Zubova, E. A.; Stamenov, I. N. (Lebedev Inst. of Physics, Moscow. Inst. of Physics, Sofia). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 609-13(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The mean values and the fluctuations of the lateral density distribution of muons with energy above 5 GeV were calculated for mountain level (700 g/cm^2) and for the energies of incident protons of 10^4, 10^5 and 10^6 GeV by two methods. It is shown that the slope of the lateral distribution function of muons is equal to 1.5 for $\langle P_\perp \rangle = 0.32$ GeV/c at distances of 10 to 100 m from the shower axis and ≈ 1 at smaller distances according to the first method and the slope is equal to ≈ 1 at distances 10 to 100 m according to the second method. The increase of the mean value of $\langle P_\perp \rangle$ up to 0.47 GeV/c reduces the slope of the lateral distribution function by 0.4. The minimum fluctuations of muon density are equal to $\approx 20\%$. (auth)

37191 THEORETICAL ANALYSIS OF EAS MUONS DETECTED DEEP UNDERGROUND. Adcock, C. (Univ. of Durham, Eng.); Wolfendale, A. W.; Wdowczyk, J. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 621-6(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The conservative model of De Beer et al. was improved and extended to predict the density spectra of muons with energy above 1000 GeV as a function of zenith angle. The derived spectra are compared with the results of Porter and Stenerson, who have observed multiple muons in the underground detector in Utah. There is good agreement between the shapes of the observed and predicted density spectra for the model, the essential features of which are a multiplicity varying as $E_p^{1/4}$ and a mean transverse momentum of 0.4 GeV/c, but there is a systematic difference in absolute intensity of a factor of about 2. (auth)

37192 FLUCTUATIONS OF NUMBER OF PARTICLES IN ELECTROMAGNETIC SHOWERS IN SUBSTANCES WITH LARGE Z. Betman, R. G.; Gedalin, E. V. (Inst. of Physics, Tbilisi, USSR). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 681-3(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The method of product probability density functions is used for calculations of the momenta of numbers of particles in showers in media with large Z, taking into account the scattering of the particles. It is shown that the calculation of the factorial momenta of numbers of particles may be reduced to quadratures. The second and third factorial momenta of the number of electrons in showers are obtained for showers initiated by electrons and photons in lead. (auth)

37193 THEORY OF RADIO-PULSE PRODUCTION. Allan, H. R. (Imperial Coll. of Science and Tech., London). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 699-704(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The radiation produced by the geomagnetic separation of positive and negative charges in an extensive air shower is calculated for a simplified model of shower structure. It is shown that the shower disc thickness does not necessarily impose a high frequency limit on the radiated spectrum: indeed for the model adopted the radio pulse wave form produced near the shower axis is essentially a delta-function with a spectrum extending (in principle) to infinite frequency. At some hundreds of meters from the shower axis the radio pulse wave form is less abrupt, and its spectrum contains fewer high frequency components. The role played by the atmospheric refractive index is shown to be relatively unimportant. (auth)

37194 RADIO-WAVE EMISSION FROM EXTENSIVE AIR SHOWERS. Fujii, M.; Nishimura, J. (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 709-15(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The emission of radiation at radio frequencies by an extensive air shower is calculated on the basis of both the one- and three-dimensional cascade theories. The interference effect owing to the lateral distribution of the sources in the shower disc is found to be important in determining the radio emissivity and the frequency dependence of this effect is different for different radiation mechanisms. Therefore, the degree of polarization of the radio waves changes with frequency. Experimental results for the polarization vs. radio frequency seem to be understandable according to this theory. (auth)

37195 POSSIBLE METHOD TO STUDY THE ELECTROMAGNETIC INTERACTIONS OF Δ(1236) ISOBARS. Nath, N. R.; Weber, H. J.; Kabir, P. K. (Univ. of Virginia, Charlottesville). Lett. Nuovo Cim.; 4: No. 4, 131-5(27 May 1972).

It is shown that the expected occurrence of ΔΔ configurations in the deuteron, with an estimated probability of about 1%, offers a possible method to measure the electromagnetic form factors of Δ(1236) isobars through photo- and electrodisintegration of the deuteron. (L.B.S.)

37196 DEEP INELASTIC ELECTRON–NUCLEON SCATTERING AND GEOMETRICAL DUALITY. Takagi, F. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 4: No. 2, 65-71(13 May 1972).

It is shown that a simple Regge expression is obtained for the scaling limit of the nucleon electromagnetic structure function by applying the concept of geometrical duality to a virtual photon-nucleon forward elastic scattering. (L.B.S.)

37197 PION EXCHANGE AND THE REACTIONS $np \to pn$, $\bar{p}p \to \bar{n}n$ AND $\gamma p \to \pi^+ n$. Engler, J.; Moennig, F.; Runge, K.; Schopper, H. (Institut fuer Experimentelle Kernphysik, Karlsruhe, Ger. CERN, Geneva). Nuovo Cim.; 9: A; No. 3, 311-18(1 Jun 1972).

A simple phenomenological model involving the interference of the pion pole with a nonspecified background is used to fit the high-energy experimental data of $np \to pn$, $\gamma p \to \pi^+ n$ and $\bar{p}p \to \bar{n}n$. In the energy range investigated, the s-dependence is only kinematical. For the form factor of the pion-nucleon coupling constant, a slope of about 2.3 $(\text{GeV}/c)^{-2}$ is found, whereas the slope of the pion trajectory is quite small. A comparison of charge exchange and photoproduction indicates that factorization holds. (auth)

37198 LIGHT-CONE COMMUTATOR AND CALLAN–GROSS SUM RULE. Lee, S. Y. (Univ. of California, San Diego, La Jolla). Phys. Rev., D; 5: No. 8, 2130-1(15 Apr 1972).

It is shown that the Callan–Gross sum rule can be rederived by the light-cone analysis of the current commutator. (auth)

37199 EFFECT OF VIRTUAL-PHOTON MASS ON TRANSVERSE-MOMENTUM DISTRIBUTIONS IN INCLUSIVE PROCESSES. Abarbanel, Henry D. I.; Kogut, John B. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., D; 5: No. 8, 2050-6(15 Apr 1972).

To investigate the idea that the transverse "size" of a photon depends on its squared mass, Q^2, some simple inclusive experiments involving virtual timelike or spacelike photons are examined. It is argued that the average transverse momentum of produced hadrons grows as $(|Q^2|)^{1/2}$ when those hadrons carry a finite fraction of the photon momentum. The basis for this is the damping in four-momentum transfer common to a variety of field-theory and multiperipheral models. Also, the decorrelation of average transverse momentum and Q^2 as the rapidity between the photon and produced hadron grows is discussed. This allows one to test factorization of Regge-pole residues in a single experiment. (auth)

37200 EQUAL-TIME COMMUTATORS OF THE ELECTROMAGNETIC CURRENT AND ITS TIME DERIVATIVES. Creutz, Michael; Sen, Siddhartha (Univ. of Maryland, College Park). Phys. Rev., D; 5: No. 8, 1937-45(15 Apr 1972).

Equal-time commutators among various components of the electromagnetic current and its time derivatives are considered. In particular the general structure of the vacuum and one-particle matrix elements of these commutators are studied. The form of the commutation relations with no time derivatives enables new relations on the commutators involving time derivatives of the current to be obtained. Using these results, possible q-number Schwinger terms are discussed in the equal-time commutator. (auth)

37201 ELECTROMAGNETIC INTERACTION OF DUAL SYSTEMS. Ramond, P. (Yale Univ., New Haven). Phys. Rev., D; 5: No. 8, 2078-84(15 Apr 1972).

The electromagnetic interaction of dual models is introduced by means of a generalized minimum-interaction principle. It leads to a conserved current and a gauge-invariant theory. Unfortunately, the strong gauge conditions are preserved only for on-mass-shell photons, which leads to unphysical poles in $k \cdot k'$. (auth)

37202 η AND PION DECAYS INTO LEPTON PAIRS. Pratap, Mahendra; Smith, Jack (State Univ. of New York, Stony Brook). Phys. Rev., D; 5: No. 8, 2020-30(15 Apr 1972).

A recent measurement of the branching ratio $\Gamma(\eta \to \mu^+\mu^-)/\Gamma(\eta \to 2\gamma)$ yielded the value $(5.9 \pm 2.2) \times 10^{-5}$. The implication of this result on theoretical predictions for the real part of the $\eta \to \mu^+\mu^-$ decay amplitude is examined and it is concluded that the branching ratio is uncomfortably large for most of the models proposed so far. The $\eta \to \mu^+\mu^-$ decay rate in the baryon loop model is then evaluated. Predictions are also made for the associated decays $\eta \to \gamma\mu^+\gamma^-$, $\pi^0 \to e^+e^-$, and $\pi^0 \to \gamma e^+e^-$. (auth)

37203 CONJECTURE ON THE APPROACH TO SCALING IN DEEP-INELASTIC ELECTRON SCATTERING AND SOME COMMENTS ON ELECTROMAGNETIC MASS DIFFERENCES. West, Geoffrey B. (Stanford Univ., Calif.). Phys. Rev., D; 5: No. 8, 1987-91(15 Apr 1972).

It is conjectured that if the equal-time commutator of the electromagnetic current with its third time derivative exists as defined by Bjorken's asymptotic expansion, then the approach to scaling in deep-inelastic electron scattering is like $1/q^2$, where q^2 is the square of the mass of the virtual photon. It is shown that in the scaling region one can expect the structure functions for charged pions to be the same as those for neutral pions. If the longitudinal structure functions vanish in the nonscaling as well as in the scaling region, then the pion mass difference, as calculated via the Cottingham formalism, converges. For nucleons, on the other hand, a similar assumption for an "almost" longitudinal structure function does not guarantee convergence. The condition that does, however, may be consistent with experiment. (auth)

37204 SINGLE-PION PHOTOPRODUCTION IN A MODEL OF HIGHER BARYON COUPLINGS. Mehrotra, Rashmi; Mitra, A. N. (Univ. of Delhi). Phys. Rev., D; 5: No. 7, 1803-23(1 Apr 1972).

Pion photoproduction of nucleons via s-channel resonances up to a total c.m. energy of ~2 GeV, and also the electromagnetic decay widths of such resonances, are investigated in a recently proposed unified model of $\bar{B}B_LP$ and $\bar{B}B_LV$ couplings. In this phenomenological model, which uses the "quark" language only formally, the couplings $\bar{B}B_LP$ of baryon resonance (B_L) with pseudoscalar (P) mesons in broken SU(6) × O(3) are extended to incorporate electromagnetic interactions through "partial symmetry" for $\bar{B}B_LV$ couplings, together with the principle of vector-meson dominance. These supermultiplet $L^P \to 0^+$ transitions are characterized by an empirical but relativistically invariant multiplying form factor, for which two different forms are considered. The calculated electromagnetic decay widths for the baryon resonances Y*(1520) and Δ(1238) are in extremely good agreement with experiment. For the other resonances no direct experimental data are available, and comparison has been made with other contemporary analyses. The results for the reactions $\gamma p \to \pi^0 p$, $\gamma p \to \pi^+ n$, and $\gamma n \to \pi^- p$ are also presented with reference to the following types of data: (i) total cross sections, (ii) the angular distribution of the differential cross sections, (iii) the energy dependence of the cross sections at fixed angles (especially $\theta = 0, \pi$), and (iv) recoil-proton polarization. The agreement with the experimental data in all these respects is extremely good, thus suggesting that the direct s channel makes a large and dominant contribution to the amplitude in the intermediate-energy region. The only discrepancy lies in the forward direction for charge-exchange processes, where the t-channel pion pole is known to be important, yet a partial simulation of duality seems to be indicated by our results. Also, the qualitative features of pionic photoproduction are reasonably well reproduced by our model. The Moorhouse selection rule for spin quartet states and a "charge" selection rule proposed recently by Copley et al. are satisfied in the limit of $m_\rho = m_\omega$ in our model. The most prominent resonances turn out to be P_{11}, P_{33}, D_{13}, F_{15}, and F_{37}. (auth)

37205 CONSISTENCY OF SPIN-ONE THEORY. Goldman, T. (Harvard Univ., Cambridge, Mass.); Tsai, Wu-yang; Yildiz, Asim. Phys. Rev., D; 5: No. 8, 1926-30(15 Apr 1972).

The energy eigenvalues of a generalized equation for the motion of the spin-1 particle in a homogeneous magnetic field are solved by using a very simple method. From the explicit expression of the eigenvalues, it is found that the spin-1 theory is consistent when the anomalous magnetic moment $\kappa(H^2)$ is a nonpolynomial function of the magnetic field strength $|H|$ that obeys certain conditions. Hence, the usual way of writing the spin-1 equation, with constant anomalous magnetic moment, is inconsistent. A particular form for $\kappa(H^2)$ which gives consistency for spin-1 theory is discussed. Some physical implications are also presented. (auth)

37206 CURRENT CONSERVATION AND THE SCATTERING OF VECTOR PARTICLES. Glueck, M. (Univ., Marburg, Ger.). Phys. Rev., D; 5: No. 8, 2014-17(15 Apr 1972).

The implications of current-conservation constraints on vector-particle scattering are studied in general and applied specifically to ρN and $\rho\Delta$ peripheral photoproduction processes. New expressions for the Born amplitudes of these processes are suggested. (auth)

37207 FIXED POLES IN COMPTON AMPLITUDES, AND THE POMERANCHUKON COUPLING. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Phys. Rev., D; 5: No. 8, 2056-62(15 Apr 1972).

The nonperturbative formulation of the parton model is used to discuss the Regge properties of current amplitudes at fixed q^2. It is shown that, in addition to j = 1 wrong-signature fixed poles due to third-spectral-function effects, there are further poles of this type associated with current-algebra anticommutators. The two types of poles combine additively with each other and multiplicatively with even-signature Regge poles. Their consequences for the coupling of the Pomeranchukon, for gauge invariance, and for deep-inelastic scattering are investigated. In particular, it is found that the coupling of the Pomeranchukon in the total cross section for photoproduction arises solely from the third-spectral-function effects and not from the current-algebra fixed pole; hence it cannot be calculated with present knowledge. The existence of a right-signature j = 0 fixed pole with residue linear in q^2 is also confirmed. (auth)

37208 QUANTUM-MECHANICAL TREATMENT OF AN ELECTRON UNDERGOING SYNCHROTRON RADIATION. White, D. (Purdue Univ., Lafayette, Ind.). Phys. Rev., D; 5: No. 8, 1930-6(15 Apr 1972).

The problem of an electron moving perpendicular to an intense magnetic field is approached from the framework of quantum mechanics. A numerical solution to the related rate equations describing the probabilities of occupation of the electron's energy states is put forth along with the expected errors involved. The quantum-mechanical approach is found to predict a significant amount of energy broadening with time for an initially monoenergetic electron beam entering a region of an intense magnetic field as long as the product of initial energy and magnetic field is of order 50 MG BeV or larger. (auth)

37209 LIGHT-CONE ANALYSIS OF VIRTUAL PROCESSES. Jackiw, Roman (Massachusetts Inst. of Tech., Cambridge); Schnitzer, Howard J. Phys. Rev., D; 5: No. 8, 2008-14(15 Apr 1972).

The leading divergences contributing to the lowest-order electromagnetic and weak effective Lagrangians are characterized in terms of the bilocal operators that emerge from light-cone algebras. Possible mechanisms for finite mass differences are discussed in this context. Speculations concerning finite electromagnetic mass differences correlate the small nonelectromagnetic isospin violation with the approximate chiral SU(2) × SU(2) symmetry of the strong-interaction Hamiltonian. (auth)

Weak

Refer also to abstract 37303.

37210 (ANL/HEP–7208(Vol.1), pp 260-308) THREE LECTURES ON WEAK INTERACTIONS. Primakoff, H. (Pennsylvania Univ., Philadelphia). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Some of the high points of weak interactions are summarized. Purely leptonic processes, semileptonic processes, new experimental results in nonleptonic processes, estimate for Λ_{SL} from dependence on E_ν in $\nu_\mu + N \rightarrow \mu^- +$ all possible hadronic states, H_{weak} in conventional Cabibbo theory, possible modifications of the leptonic weak current and their observational consequences, and possible modifications of the hadronic weak current are treated. (J.F.P.)

37211 (ANL/HEP–7208(Vol.1), pp 309-29) LECTURES ON WEAK INTERACTIONS THEORY. Oakes, R. J. (Northwestern Univ., Evanston, Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The lectures on weak interactions cover the Cabibbo theory, nonleptonic processes, the $K_2^0 \rightarrow \mu^+ + \mu^-$ debacle, semileptonic K decays, and semileptonic baryon decays. (J.F.P.)

37212 (ANL/HEP–7208(Vol.1), pp 342-4) REVIEW OF Ξ^- DECAY MODES. Rosen, S. P. (Purdue Univ., Lafayette, Ind.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The review of Ξ^- decay modes covers the $\Delta T = \frac{1}{2}$ rule, the various branching ratios, and Cabibbo theory. (J.F.P.)

37213 (ANL/HEP–7208(Vol.1), pp 345-8) RE-EXAMINATION OF THE CABIBBO FIT TO HYPERON β-DECAY. Winston, R.; Linsay, P. S. (Chicago Univ., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

It is pointed out that when correlations with the hyperon spin are included the Cabibbo model is no longer successful in correlating data on hyperon beta decays. Also a way to extend the standard Cabibbo fit to account for the polarized hyperon data is suggested. (J.F.P.)

37214 (ANL/HEP–7208(Vol.3), pp 978-87) WEAK INTERACTION EXPERIMENTS WITH THE 12-FT BUBBLE CHAMBER. Cho, Y. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Various features of the 12-foot bubble chamber for weak interaction experiments, in particular, for K_L decay studies are pointed out. The decay properties of K_{e3} and $K_{\mu 3}$ are briefly reviewed, and the quantities to be measured are discussed. The decay parameters for $K_L \rightarrow 3\pi$, K_{l3}^+, and Ξ^- decays are also briefly discussed. (L.B.S.)

37215 RADIATIVE CORRECTIONS TO MUON DECAY IN AN INTERMEDIATE VECTOR-BOSON THEORY. Vegte, R. C. (State Univ. of New York, New Paltz); Haller, K. Nuovo Cim.; 9A: No. 2, 187-98(21 May 1972).

The radiative corrections to the decay spectrum for polarized muons are evaluated by means of an intermediate vector-boson theory. The vector-boson propagator has a form that makes all integrals renormalizable by conventional means. The renormalization of the weak by the electromagnetic interactions is discussed. It is shown how a prescription given by Durand, Landovitz and Marr facilitates the proper cancellation of infra-red divergences in the finite residues of the vertex and self-energy parts after ultraviolet infinities have been absorbed into the renormalized coupling constants. The results of the calculation are in good agreement with the radiatively corrected Fermi-coupling theory and show great insensitivity to the mass of the intermediate vector-boson in the large-mass regime. (auth)

37216 HEURISTIC MODEL OF THE MUON. Ross, D. K. (Iowa State Univ., Ames). Nuovo Cim.; 9A: No. 2, 254-62 (21 May 1972).

A model of the muon is constructed in which a massless spin-1 wave, designated the wavon, orbits an electron on a null-geodesic path. The radius of the orbit is given by general-relativistic considerations: the wavon orbits where the effective gravitational force is zero. The mass of the muon is the mass of the electron plus the energy of the wavon derived from quantum mechanics. The result $m_\mu = m_e(1 + \frac{3}{2}\, 1/\alpha)$, where α is the fine-structure constant, yields $m_\mu = m_e(206.554)$, in good agreement with the experimental mass ratio of 206.767. (auth)

37217 INTERMEDIATE η MESON IN $K_L \rightarrow 3\pi$ AND $K_L \rightarrow 2\gamma$. Devlin, Thomas J. (Rutgers—The State Univ., New Brunswick, N. J.). Phys. Rev., D; 5: No. 7, 1674-5(1 Apr 1972).

The amplitude responsible for the apparent violation of the $\Delta I = \frac{1}{2}$ rule in $K \rightarrow 3\pi$ decay is discussed. It is compared with the amplitude responsible for the decay $K_L \rightarrow 2\gamma$. Under the assumption that both are dominated by an intermediate-state η meson, there is excellent quantitative agreement between them. Contributions of this intermediate state to $K_L \rightarrow \pi\pi\gamma$ and $K_L \rightarrow \pi\gamma\gamma$ are calculated. (auth)

37218 PRODUCTION CROSS SECTIONS FOR LEE–WICK MASSIVE ELECTROMAGNETIC BOSONS AND FOR SPIN-ZERO AND SPIN-ONE W BOSONS AT HIGH ENERGIES. Linsker, Ralph (Columbia Univ., New York. Goddard Space Flight Center, New York). Phys. Rev., D; 5: No. 7, 1709-23(1 Apr 1972).

The total cross section is calculated for the resonant process $1^\pm + Z \rightarrow 1^\pm + Z' + B^0 \rightarrow 1^\pm + Z' +$ (hadrons or leptons), where $1 = \mu$ or e, and B^0 is the hypothetical massive spin-1 boson of electromagnetic interactions, proposed by Lee and Wick. Several (Z,Z′) cases have been studied, corresponding to elastic scattering off protons and neutrons (with and without an exclusion principle), coherent scattering off spin-0 nuclei, and inelastic scattering off protons (in the case Z′ denotes a nucleon resonance or hadronic system in the continuum). Detailed structure-function data are used to improve the accuracy of the inelastic scattering calculation. At a beam energy of 200 to 300 GeV, the cross section exceeds 10^{-36} cm^2, provided the B^0 mass is not much greater than 10 GeV. Details of the calculation are given with results for beam energies between 50 and 10 000 GeV and B^0 masses between 5 and 40 GeV. The cross section is also computed for the resonant process $\bar{\nu}_1(\nu_1) + Z \rightarrow 1^\pm + Z' + W_0^\mp \rightarrow 1^\pm + Z' +$ (hadrons or leptons) and for the extensively studied semiweak process $\bar{\nu}_1(\nu_1) + Z' \rightarrow 1^\pm + Z' +$

$W_1^{\mp}$, where $W_{0.1}^{\pm}$ are the scalar and vector weak intermediate bosons. The cross section for $W_0^{\pm}$ production with $l = \mu$ is found to be at least an order of magnitude smaller than that for $W_1^{\pm}$, in nearly all regions of interest. The $W_0^{\pm}$ production cross section for inelastic scattering off protons is comparable to that for elastic scattering in the regions of interest; whereas in the B^0 and $W_1^{\pm}$ cases, the main contribution to the total cross section for production off protons is elastic. (auth)

37219 EXPERIMENTAL TESTS OF WEINBERG'S THEORY OF LEPTONS. Chen, Herbert H. (Univ. of California, Irvine); Lee, Benjamin W. Phys. Rev., D; 5: No. 7, 1874-7(1 Apr 1972).

Some experimental consequences of Weinberg's unified theory of weak and electromagnetic interactions of leptons, which may be renormalizable, are discussed. Comment is made on the extant experimental data bearing on this theory (such as the data on the processes $\nu_\mu + e \rightarrow \nu_\mu + e$, $\bar{\nu}_e + e \rightarrow \bar{\nu}_e + e$), and on possible future refinements of these data. A bound is obtained on a parameter of the theory. (auth)

37220 PHYSICAL ADSORPTION AT SEMICONDUCTING SURFACES. Peshev, O. (Univ. of Plovdiv, Bulgaria). Lett. Nuovo Cim.; 4: No. 3, 91-2(20 May 1972).

The differential and total cross sections of deep inelastic neutrino-nucleon and antineutrino-nucleon interactions are given from the 3-quark-boson-nucleon model previously constructed from the study of deep inelastic eN scattering. The results obtained agree with CERN data and give quantitative relations between the deep inelastic eN and νN, $\bar{\nu}$N interactions. (L.B.S.)

37221 TEMPERATURE EFFECT AND MECHANISM OF PRODUCING HIGH-ENERGY MUONS IN THE ATMOSPHERE. Volkova, L. V.; Zatsepin, G. T. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 153-5 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Temperature coefficients of high-energy atmospheric muons are calculated and are shown to be sensitive to the muon production mechanism, i.e. to the ratio of kaons and pions produced by primary cosmic rays in interactions with nuclei in the atmosphere and to a possible direct production of muons. (auth)

37222 ANALYSIS OF CROSS SECTION OF DIRECT PAIR PRODUCTION BY FAST MUONS. Kokoulin, R. P.; Petrukhin, A. A. (Moscow Engineering Physics Inst.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 4, 277-84(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

An exact analytical expression for the cross section of electron pair production by fast muons is found. The dependence of the total cross section on the muon energy is obtained. The ratio of the number of cascade showers initiated by pair production by cosmic muons to the number of those initiated by bremsstrahlung process is calculated. (auth)

37223 WEAK NEUTRAL CURRENTS AND THE $K_L \rightarrow \mu^+ + \mu^-$ PUZZLE. Treiman, S. B. Commets Nucl. Particle Phys.; 5: No. 2, 35-8(Mar-Apr 1972).

It is stated that the role of neutral currents in weak interaction phenomenology is at present attracting much attention, arising in connection with recent developments in the search for proper field theoretical models of weak interactions, and in particular the broken gauge symmetry model. Experimentally, however, there is no evidence for neutral current effects, but they represent important matters to be searched for experimentally. A good candidate for experimental work is the reaction $K_L \rightarrow \mu^+ + \mu^-$, but the complication arises that this process can also arise from a standard electrodynamic mechanism, according to the sequence $K_L \rightarrow$ two real or virtual photons $\rightarrow \mu^+ + \mu^-$. A possibility exists that CP violation, hitherto ignored, plays an unexpectedly important role. 8 references. (UK)

37224 EQUIVALENCE BETWEEN THE S MATRIX AND POTENTIAL FORMALISM OF $K_S - K_L$ DECAY. Kumar, Sudhir (Univ. of Notre Dame, Ind.). Phys. Rev., D; 5: No. 8, 2128-30 (15 Apr 1972).

It is shown that an S matrix for two overlapping resonances can always be written exactly in a form derivable from a potential theory of scattering. The overlap between resonant states and the matrix elements of a Hermitian potential are explicitly constructed in terms of the parameters of the given S matrix. (auth)

37225 CURRENT ALGEBRA IN TWO-PARTICLE BASES AND SINGLE-PARTICLE INCLUSIVE PROCESSES. Chang, Lay Nam (Univ. of Pennsylvania, Philadelphia); Fujikawa, Kazuo. Phys. Rev., D; 5: No. 8, 2041-9(15 Apr 1972).

Several problems involved in the current-algebra sum rules derived by Suzuki and his collaborators are discussed. In particular the ambiguities related to soft-current insertion to the external lines are discussed. Alternative prescriptions to get similar sum rules are also discussed. An application of the sum rule to the W-production process is briefly discussed. (auth)

Strong (General)

Refer also to abstracts 37118 and 37323.

37226 (ANL/HEP-7208(Vol.1), pp 151-3) THEORETICAL DIRECTIONS IN TWO-BODY REACTIONS. Kane, G. L. (Michigan Univ., Ann Arbor. Dept. of Physics). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The information to be obtained, the purpose of the study, and the important energies, angles, and reactions in two-body strong interactions are summarized. The study of duality is emphasized. (J.F.P.)

37227 (ANL/HEP-7208(Vol.2)) PLANNING FOR THE FUTURE. ZERO GRADIENT SYNCHROTRON WORKSHOPS, SUMMER 1971. Proceedings of a Series of Seven Workshops Held at Argonne National Laboratory, June 3-August 5, 1971. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 331p. Dep. NTIS.

The conference included 10 papers. Separate abstracts were prepared for all papers. (J.F.P.)

For abstracts of individual papers see: 36202, 36682, 37072, 37073, 37117–37119, and 37249–37251.

37228 (ANL/HEP-7208(Vol.3), pp 800-13) TWO-BODY REACTION MECHANISMS. Pumplin, Jon (Michigan State Univ., East Lansing). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Two-body and quasi-two-body reactions are discussed. At reasonably high energies, the forward and backward peaks can be separated out, and thereby the quantum numbers in the crossed channel that are being exchanged can be identified. The following reaction types are discussed: elastic scattering, diffraction dissociation, particle exchange, and t-channel exotic exchange. Comments are given on the physical picture that emerges from the Regge model. (L.B.S.)

37229 (ANL/HEP-7208(Vol.3), pp 920-48) SECONDARY INTERACTIONS OF HADRONS. Button-Shafer, J. (Massachusetts Univ., Amherst). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Attention is focused on the utility of secondary interactions in the 12-foot chamber, where 10 to 15% probabilities are likely for some processes. Some of the processes discussed are $K^+ + p \rightarrow \bar{K}^0 + n$, pp and np elastic scattering, $p + p \rightarrow \pi^+ + d$, hyperon and kaon interactions, and hyperon decays. The comparison of information gained through secondary scattering of baryons in the 12-foot chamber with that obtained by the use of polarized targets is discussed. (L.B.S.)

37230 (ANL/HEP-7208(Vol.3), pp 1061-71) EXPERIMENTS WITH POLARIZED TARGETS. Yokosawa, A. (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Earlier experiments performed during 1963 to 1964 are first listed. The experiments performed up to the present to measure polarization parameters are reviewed in two parts: high-energy region (above 3 GeV/c), and the low-energy region. The physics accomplished by polarization measurements is discussed. Currently running or planned experiments are then described. (L.B.S.)

37231 (ITF-72-23-E) ANALYTIC CONTINUATION OF DAMA. I. Bugrii, A. I.; Jenkovskii, L. L.; Kobylinskii, N. A.; Shelest, V. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 15p. Dep. NTIS (U. S. Sales Only).

An analytic continuation of the dual amplitude with Mandelstam analyticity to the domain of positive values is given. The pole structure of the amplitude and its asymptotic behavior are investigated. (auth)

37232 (JINR-P2-6357) AVERAGE MULTIPLICITIES OF SECONDARY PARTICLES IN HADRON-HADRON COLLISIONS. Grishin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR).

Lab. of High Energy). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

The ratios between the values of the average multiplicities of different secondary particles are derived for the process of the multiple hadron production. These ratios result from the isotope and charge invariance, conservation of strangeness law, electrical and baryon charges. The ratios can be used both for testing the isotope and charge invariance at superhigh energies and for obtaining information about the secondary particle nature. Analogous ratios are obtained for the model of limiting fragmentation. (auth)

37233 NOVA MODEL OF INCLUSIVE REACTIONS. Jacob, M.; Slansky, R. (Yale Univ., New Haven). Phys. Rev., D; 5: No. 7, 1847-70(1 Apr 1972).

A model for particle production is presented in which the features recently observed in inclusive distributions can be reproduced. The calculation emphasizes the role of resonance-like objects which are diffractively produced and decay mainly through cascade emission of pions. The cross section for producing these objects which we call novas is diffractive and does not depend on energy. As a function of nova mass it rises to a low mass maximum (below 2 GeV) and falls off in a way which is controlled by Regge behavior and duality. A zero-parameter model is then constructed for the inclusive distributions which also gives many predictions about exclusive reactions. Among the many features which can be obtained in terms of this picture are: the rapid approach of scaling for secondaries with relatively large center-of-mass momentum; a slower approach for soft secondaries and the pseudo-scaling observed at present machine energy in certain reactions; a simple connection between the transverse-momentum distribution, the longitudinal-momentum distribution, and the average multiplicity of secondaries; charge effects which should not vanish asymptotically; and a marked difference between meson and baryon distributions. The approach to scaling is connected to the rise of the diffractive cross section as inferred from the behavior of the K^+p total cross section. One also obtains an understanding for the "quark frame" results and the center-of-mass isotropy of slow secondaries. (auth)

37234 CORRELATION FUNCTIONS IN HIGH-ENERGY MULTIPLE PRODUCTION AND AN EXTENSION OF FEYNMAN'S GAS ANALOG. Arnold, Richard C. (Argonne National Lab., Ill.). Phys. Rev., D; 5: No. 7, 1724-8(1 Apr 1972).

A picture of multiple-production cross sections suggested by Feynman is extended to include transverse-momentum distributions and phase-space boundary effects in the single-particle distributions by introducing an external confining potential on an axially symmetric plasma. Two-particle correlation functions are discussed in such an analog system, using closure approximations such as the Debye–Hückel equation for a nonuniform plasma, with the interparticle potentials obtained from two-particle elastic scattering properties. Effective correlation lengths are found to depend on the single-particle distribution in important ways. In particular, the central-region correlations are of shorter range than those at large transverse momentum or near phase-space boundaries in certain cases. A bootstrap mechanism for indefinitely rising Regge trajectories is also outlined. (auth)

37235 $f^0-A_2^0$ INTERFERENCE AND THE $f^0 \to K\bar{K}$ BRANCHING RATIO. Biswas, N. N.; Cason, N. M.; Harrington, E. A.; Kenny, V. P.; Shephard, W. D. (Univ. of Notre Dame, Ind.). Phys. Rev., D; 5: No. 7, 1564-9(1 Apr 1972).

Interference in the $K\bar{K}$ decay mode of the f^0 and A_2^0 mesons is discussed in terms of the mass-matrix formalism. It is shown that the measurement of the $f^0 \to K\bar{K}$ branching ratio can be in error by an order of magnitude if interference is not properly accounted for. Data from π^+p and π^-p reactions at 18.5 GeV/c are used to determine the $(f^0 \to K\bar{K})/(f^0 \to \pi\pi)$ branching ratio R_{f^0} using the known $A_2 \to K\bar{K}$ branching ratio and assuming a value for the coherence factor. $9\% \leq R_{f^0} \leq 18\%$ is found. (auth)

37236 HIGH-ENERGY BEHAVIOR OF THE AVERAGE MULTIPLICITY. Bassetto, A. (CERN, Geneva); Toller, M.; Sertorio, L. Lett. Nuovo Cim.; 4: No. 3, 73-8(20 May 1972).

An upper bound on the invariant amplitude for the production of n particles in multiperipheral dynamics was previously derived and is used to study the properties of the average multiplicity. A logarithmic upper bound on the average multiplicity is obtained, from which is concluded that if the average multiplicity is found to increase asymptotically faster than log s, the multiperipheral dynamics model has to be abandoned. (L.B.S.)

37237 PRINCIPLE OF SEPARABILITY IN HIGH-ENERGY REACTIONS. Mori, K. (Saitama Univ., Japan); Nakamura, H. Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 131-4(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A new theory of high-energy hadronic collisions is proposed on the basis of the experimental evidence on the H-quantum introduced by Hasegawa. (auth)

37238 DEPENDENCE OF MEAN TRANSVERSE MOMENTUM OF PRODUCED PARTICLES ON COLLISION ENERGY. Jabs, A. (Univ., Kiel). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 253-8 (1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

In order to be able to describe the production of particles in high-energy collisions by thermodynamics the temperature must be kept below a certain figure because of the experimental finding that the mean transverse momentum $\bar{p}_t$ of the produced particles is nearly constant above the collision energy of ≈7 GeV. On the other hand, Lorentz-invariant phase space calculations show that the mean kinetic energy of a particle, which corresponds to the temperature, also reaches an upper limit at high energy. This behavior, however, results only if the interaction volume is kept constant, i.e., if there is no Lorentz contraction. As the collision energy rises from 30 GeV to infinity, $\bar{p}_t$ increases by an estimated factor of less than 3. (auth)

37239 EXISTENCE OF FIREBALLS. Daibog, E. I.; Rozental, I. L. (Moscow State Univ. Inst. for Space Research, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 267-70(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A critical analysis of the experimental evidence of the existence of fireballs is presented. Particular attention is paid to the two maxima in the angular distribution plotted in logarithmic coordinates. The conclusion is drawn that the two maxima arise in consequence of the limitation of the transversal momenta of secondary particles. (auth)

37240 NEW MASS FORMULA OF ELEMENTARY PARTCLES. I. Muraki, Y. (Nagoya Univ., Japan). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 297-301(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Masses of elementary particles are expressed in terms of a logarithmic function of an integer number: $M_n c^2 = -K + \xi \ln (n)$. The mass formula is interpreted as a composite model and a fundamental force between urbaryons which are assumed to be the constituents of fireballs. The mass formula is applied to give an explanation of cosmic ray phenomena. (auth)

37241 PROPAGATION OF COSMIC RAYS IN THE ATMOSPHERE AND MODELS OF MULTIPLE MESON PRODUCTION. I. Fujimoto, Y.; Hasegawa, S.; Kasahara, K.; Ohsawa, A.; Shibata, T. (Waseda Univ., Tokyo). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 303-9(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Calculations are made on the production and diffusion in the atmosphere of various cosmic ray components on the basis of three theories of multiple production: the H-quantum model, the two-fireball model, and the aleph model. Comparison is made with a huge emulsion chamber experiment. The best fit of experimental values is found for the H-quantum model. (auth)

37242 COMPOSITE THEORY OF LARGE ANGLE SCATTERING AND NEW TESTS OF PARTON CONCEPTS. Gunion, J. F.; Brodsky, S. J.; Blankenbecler, R. (Stanford Univ., Calif.). Phys. Lett.; 39B: No. 5, 649-53(29 May 1972).

A formalism for handling the scattering of composite systems is presented. Using this formalism, the contribution to bound state scattering at large energy and angle from the interchange force is calculated. This force leads to elastic cross sections which behave at fixed angles like the sixth power of the form factor and for which $(d\sigma/dt)/(d\sigma/dt)_{90^\circ}$ is an energy independent function of z. Comparison with p-p and π-p data shows excellent agreement. A new test of the existence of a pointlike coupling of the photon to partons is suggested. (auth)

37243 ENERGY AND ELECTRIC DIPOLE MOMENT OF THE ONE-ELECTRON QUARK MOLECULES. Bar-Ziv, E.; Katriel, J. (Nuclear Research Center, Beer-Sheva, Israel). Nature (London) Phys. Sci.; 237: No. 71, 32(8 May 1972).

The energy and electric dipole moment were evaluated for both the $+\frac{1}{3}e$ and $+\frac{2}{3}e$ species, over a range of proton-quark distances, using a variational calculation with an extensive set of Gaussians. The equilibrium parameters were in satisfactory agreement with the exact values obtained by Goto and others (Phys. Rev. A, 4:

1380(1971)). The electronic dipole moment was evaluated with regard to the position of the proton, but for spectroscopic purposes it should be evaluated with respect to the center of mass. The molecular center of mass, however, should be quite close to the quark, and the total electric dipole moment with respect to the center of mass is therefore almost equal to the electronic dipole moment with respect to the proton. If the quark mass is about ten times higher than the protonic mass, the required correction is <10% in the most interesting range of proton-quark distances. The systems considered may produce vibrational and rotational spectra, as well as a second-order Stark effect. In view of the very low upper bounds estimated for the terrestrial concentration of quarks it would seem impossible to make laboratory observations of such spectra, but the high cosmological abundance of atomic H may, however, establish favorable conditions for experimental work. (UK)

37244 DYNAMICAL PARTON MODEL FOR HADRONS. Tryon, E. P. (Hunter Coll., New York). Phys. Rev. Lett.; 28: No. 24, 1605-8(12 Jun 1972).

Assuming that hadrons are bound states of large numbers of partons and antipartons, it is argued that the hadronic medium is characterized by a tension which is independent of the amount by which it has been stretched. The dynamically stable configurations of such a medium are spinning loops, where the tension is balanced against the centrifugal force. The corresponding Regge trajectories are in excellent agreement with experiment, but rise only like $s^{3/4}$ for large s. (auth)

37245 LOOP GRAPH IN THE DUAL-TUBE MODEL. Shapiro, Joel A. (Univ. of Maryland, College Park. Rutgers–The State Univ., New Brunswick, N. J.). Phys. Rev., D; 5: No. 8, 1945-8(15 Apr 1972).

The one-loop graph in the dual-tube model is constructed. The conditions for no divergences or new singularities are exactly those found by Lovelace for factorization of the "Pomeranchukon" in the strip model. Loops correspond to electrostatics on multiple tori only if spurious particles are permitted to circulate in the loops. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 37309.

37246 (ANL/HEP–7208(Vol.1), pp 92-103) THEORIST'S REVIEW OF $\pi\pi$ AND $K\pi$ SCATTERING. Kane, G. (Michigan Univ., Ann Arbor). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The topics reviewed are the theoretical interest of $\pi + \pi$ and $K + \pi$ scattering, the means of obtaining a more accurate extrapolation, and the credibility of a general model of a whole reaction in both s and t without a detailed extrapolation. (J.F.P.)

37247 (ANL/HEP–7208(Vol.1), pp 129-31) EXTRAPOLATIONS OF $\pi\pi$ AMPLITUDES BY ANALYTIC APPROXIMATION. Shih, C. C. (Carnegie-Mellon Univ., Pittsburgh, Pa.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Some aspects of extrapolating $\pi + \pi$ amplitudes from single π production processes using modern analytic approximation theory are discussed. Optimal phenomenological representations which have the largest convergence rate and are stable against experimental error are sought with avoidance of model dependence. The function F derived from π production cross sections $F = (t_1 - \mu^2)^2\, d\sigma/d\Phi$, where Φ is the phase space factor, is discussed. (J.F.P.)

37248 (ANL/HEP–7208(Vol.1), pp 132-40) PLANAR DUALITY AND EXTRACTING $\pi\pi$ SCATTERING INFORMATION FROM THE DALITZ PLOT OF $\bar{N}N-3\pi$. Sivers, Dennis (Argonne National Lab., Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

In the framework of the dual narrow resonance model the extraction of information on $\pi\pi$ scattering from the Dalitz plot of the reaction $\bar{p} + n \rightarrow \pi^+ + 2\pi^-$ is discussed. The discussion is qualitative and relies only on those aspects of the model which are widely accepted. The conclusions do not depend on the results of detailed fits involving Veneziano functions. (J.F.P.)

37249 (ANL/HEP–7208(Vol.2), pp 445-94) REVIEW OF STRANGE BOSONS. Barnes, Virgil E. (Purdue Univ., Lafayette, Ind. Dept. of Physics). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

K^* resonances are reviewed stressing newer values for properties of known states, new states, and some phenomenological observations about regularities based on SU(3), the simple quark model, linear Chew–Frautschi plots, and current algebra. The absence of exotics with $I = 3/2$ or $S = 2$, splitting or structure in the K(1420) mass distribution, resonant phase shifts from $K\pi$ scattering, the Q meson and a possible $J^P = 1^+$ eighteen-plet of mesons, properties of the K(1420) the L meson or $K_A(1760)$, a new K^*_N (1760) and other possible high-mass states, the electromagnetic mass difference of the K(890) and K(1420), and other new 0^+ states are discussed. (J.F.P.)

37250 (ANL/HEP–7208(Vol.2), pp 495-530) SPECTRUM OF LOW-LYING HADRON STATES. Rosner, Jonathan L. (Minnesota Univ., Minneapolis. School of Physics and Astronomy). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The low-lying meson and baryon states are reviewed from various theoretical standpoints, with particular emphasis on the quark model scheme of classification. Experiments to fill gaps are suggested where possible. (auth)

37251 (ANL/HEP–7208(Vol.2), pp 648-90) CENTRIFUGAL BARRIER EFFECTS IN RESONANCE PARTIAL DECAY WIDTHS, SHAPES, AND PRODUCTION AMPLITUDES. von Hippel, Frank (Argonne National Lab., Ill.); Quigg, C. (State Univ. of New York, Stony Brook. Inst. for Theoretical Physics). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The experimental status of identifiable centrifugal barrier effects in: shapes of resonances, accounting for deviations in SU(2) and SU(3) predictions for ratios between partial decay widths, and accounting for the dependence on spin of the elastic widths of resonances lying on the same Regge trajectory, is reviewed. A contour plot is presented from which the "kinematic partial width" (centrifugal barrier penetration factor times two body phase space) of any resonance into any decay channel may be obtained immediately, given the orbital angular momentum, semiclassical impact parameter, and an assumed strong interaction radius. Using this technique the kinematically preferred decays of the high-spin mesons on the leading meson trajectory (assumed linear) are displayed as an example. An approximate lower bound on the strong interaction radius is obtained on the basis of general considerations. It is shown that, for high-spin resonances, it can be expected that the mass enhancements in different decay channels associated with these resonances may be shifted by a half width or so with respect to each other, because of different centrifugal barrier effects in the different channels. It is also shown that production cross sections of high-spin particles on leading linear trajectories by either formation or peripheral processes will be substantially suppressed by centrifugal barrier effects. Finally, it is observed that the production cross sections and decay widths of mesons on the leading trajectory of the Veneziano model can be understood almost entirely on the basis of kinematical considerations if the radius of the region in which the decay particles interact strongly grows linearly with the mass of the decaying resonance. (auth)

37252 (ANL/HEP–7208(Vol.3), pp 917-19) $\bar{p}p$ INTERACTIONS AT HIGH ENERGY. Oren, Y. (Tel Aviv Univ. (Israel)). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Some of the problems encountered in the analysis of multiprong (≥6 prong) $\bar{p}p$ interactions at 7 GeV/c are first briefly discussed. The question of where and how can the 12-ft chamber be useful in analyzing such reactions is then discussed. (L.B.S.)

37253 (DESY–72/11) MESONS AS A RELATIVISTIC FERMI-QUARK–ANTIQUARK SYSTEM WITH STRONG BINDING. Boehm, M.; Joos, H.; Krammer, M. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1972. 47p. Dep. NTIS (U. S. Sales Only).

A quark model with heavy spin-½ quarks is discussed for the mesons with the help of a Bethe–Salpeter equation for the amplitudes $\langle 0|T(\psi_\alpha(\frac{x}{2})\bar{\psi}_\beta(-\frac{x}{2})|\begin{smallmatrix} M & j^{\pi C} \\ P & j_3 \end{smallmatrix}\rangle$ where $\psi, \bar{\psi}$ denote covariant Dirac quark fields. The Wick rotated BS equation with harmonic kernels of convolution type with general spin dependence is solved, starting from a new class of exact solutions of the 0(4)-symmetric bound-state mass-zero case. It is shown that an interaction of the P + V – S type reproduces the low-mass mesons of the nonrelativistic quark model lying on linear Regge trajectories. A complete list of the covariant, field theoretically normalized BS amplitudes for all mesons is given. As a first application, the decay constant of the pion, f_π, and the leptonic decay constants of the vector mesons, γ_V, are calculated. f_π depends on the quark mass and is for heavy quarks consistent with PCAC. (auth)

37254 (ITF-72-11-E) STATISTICAL THEORY VIEW OF THE DUAL RESONANCE MODEL. Gorenstein, M. I.; Makarov, V. I.; Miranskii, V. A.; Shelest, V. P.; Zinov'ev, G. M. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 8p. Dep. NTIS (U. S. Sales Only).

A statistical treatment of the system of levels in dual resonance model is employed to calculate the distribution of resonance spins. An average value of spin DRM is obtained, and the essentially nonlinear nature of "effective" Regge trajectory is shown. The procedure presented can prove a useful tool in investigating other averaged characteristics of dual resonances. (auth)

37255 (ITF-72-17-E) ARGAND PLOTS FOR THE QUASI-POTENTIAL AMPLITUDE FOR pp- AND $\bar{p}$p-SCATTERING. Ilyin, V. V.; Jenkovskii, L. L.; Kobylinskii, N. A.; Tutik, R. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 9p. Dep. NTIS (U.S. Sales Only).

The expression for the partial amplitude is derived from the quasipotential equation. The Argand plot for the lowest partial waves for pp- and $\bar{p}$p-scattering is constructed. (auth)

37256 BOOTSTRAP CALCULATION OF THE K* MESON USING THE EFFECTIVE-POTENTIAL METHOD. Everett, Allen E. (Tufts Univ., Medford, Mass.). Phys. Rev., D; 5: No. 7, 1681-5(1 Apr 1972).

The effective-potential method of Balázs, with tensor-meson as well as vector-meson exchange included as suggested by an earlier calculation in the $\pi\pi$ case, is used to calculate πK scattering. Taking the strengths of the potentials due to the exchange of other particles from the experimental parameters of the particles, the K* is bootstrapped, and self-consistent values are obtained for the K* mass and width of 930 MeV and 50 MeV, in very good agreement with experiment. Some uncertainty in the predicted values, especially of the mass, results from the necessity of using SU(3) to obtain the $\rho K\bar{K}$ coupling, and the fact that the experimental values of the ρ and K* widths suggest substantial SU(3) breaking. Results for other partial waves of the πK system are presented, and output K* and K** Regge trajectories, with slopes about $\frac{1}{2}$ and $\frac{1}{3}$ of the "canonical" value of 1 BeV^{-2}, respectively, are obtained. (auth)

37257 K-MATRIX MODEL OF LOW ENERGY πK SCATTERING. Afonin, A. A. (Inst. of High Energy Physics, Alma-Ata, USSR). Yadern. Fiz.; 15: No. 3, 591-6(Mar 1972). (In Russian).

In the frame of the considered model it is shown the experimental πK scattering data may be explained without a $\varkappa$-meson hypothesis. (auth)

37258 DECAY AMPLITUDES AND RESONANCES. Kerler, W. (Univ., Marburg, Ger.). Z. Phys.; 239: No. 3, 266-75 (1970).

The structure of a type of decay amplitudes, which was considered recently and its connection to scattering amplitudes (of arbitrary arrangement channel cases), to conventional decay amplitudes, and to the energy distribution is worked out in detail. The meaning of unperturbed energies in usual approaches is clarified. The considerations include the case of overlapping resonances. Sum rules for transition amplitudes, such as are of interest for neutral kaon decays, are rigorously derived. The exact interrelation between various approaches are shown. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 37116 and 37124.

37259 (ANL/HEP-7208(Vol.1), pp 168-81) EQUIVALENCE OF REGGE AND OPTICAL MODELS. Hendry, Archibald W. (Indiana Univ., Bloomington. Dept. of Physics). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The Regge and optical models are discussed for π + p interactions at intermediate energies. The discussion includes surface scattering and partial wave analysis of typical Regge terms. (J.F.P.)

37260 (ANL/HEP-7208(Vol.3), pp 1028-38) INTERMEDIATE ENERGY Ξ PHYSICS. Yodh, G. B. (Maryland Univ., College Park). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The objectives of intermediate energy Ξ physics are pointed out: determination of the number of Ξ levels below 2.5 GeV; measurement of I, J^P; measurement of branching ratios; and study of production mechanisms to determine baryon Regge exchange parameters as well as to investigate possible evidence for exotic meson exchanges. Two possible approaches for studying Ξ levels from K$^-$ interactions at intermediate energies are briefly discussed: a counter spark chamber experiment with a selective trigger or a bubble chamber experiment in a large bubble chamber. (L.B.S.)

37261 (ANL/HEP-7208(Vol.3), pp 1072-83) EXPERIMENTS WITH POLARIZED TARGETS. Fox, Geoffrey (California Inst. of Tech., Pasadena). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A summary is given of discussions on two topics: the analysis of simple meson-baryon scattering ($0^- \frac{1}{2}^+ \to 0^- \frac{1}{2}^-$); and polarization in 2 → 3 processes and, more generally, 2 → N processes. (L.B.S.)

37262 (ANL/HEP-7208(Vol.3), pp 1140-5) SOME NEW EXPERIMENTS WITH POLARIZED TARGETS. Reay, N. W. (Ohio State Univ., Columbus). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Two experiments from which direct information can be obtained about the classical properties of particles are pointed out. The first is a direct measurement of the ratio of $(\Lambda\text{-p})/(\pi\text{-K})$ relative parities from measurement of the asymmetry of Λ production from a polarized target. The second experiment is concerned with polarization studies in pairs of reactions in which one exchanged pole changes sign. Some polarization data for K$^+$p and K$^-$p forward elastic scattering are given. (L.B.S.)

37263 SOME CRITICAL REMARKS ON TWO RECENTLY PROPOSED MODELS OF THE BEHAVIOR OF ELASTIC SLOPE PARAMETERS IN HADRON–HADRON SCATTERING. Weare, T. J. (Oxford Univ.). Nuovo Cim.; 9A: No. 2, 173-86(21 May 1972).

Two previously proposed models for the structure of elastic-diffraction slopes in hadron–hadron collisions are discussed. One of them, the geometrical Regge model of Barger and Cline, fails to describe the shrinkage-antishrinkage pattern for which it was proposed. (auth)

37264 MODELS FOR DIFFRACTION SCATTERING WITH FIXED POLE AND SHIELDING CUT. Friedman, D. (Univ. of Chicago). Nuovo Cim.; 9A: No. 2, 219-34(21 May 1972).

It is proposed that the nonshrinking πp diffraction peak is due to a fixed pomeron, t-channel unitarity being preserved by a shielding cut, which also explains the constancy of high-energy total cross sections. Several models are discussed and used to fit πp and pp data; in some a new pole is assumed near the pomeron. (auth)

37265 PION–NUCLEON P-WAVE SCATTERING AMPLITUDES AND THEIR S-MATRIX CALCULATIONS. Sachl, V. F. (Univ. of Durham, Eng. Inst. of Physics, Prague). Phys. Rev., D; 5: No. 7, 1695-1701(1 Apr 1972).

The effective-range formulas for the P-wave scattering amplitudes, I = $\frac{1}{2}$ and I = $\frac{3}{2}$, of pions on nucleons are derived for the low-energy region using the requirements of analyticity, unitarity, and crossing symmetry and a sum rule. The S-matrix calculations are carried out by the generalized one-channel Chew–Mandelstam method in which the denominator function D may, generally, contain a Castillejo–Dalitz–Dyson (CDD) pole, while the function N is considered in the three-pole effective-range approximation. The effective-range parameters are then determined by the usual procedure in which the input values are the ρ-meson and (3,3)-isobar N* discontinuities and the high-energy contributions in the crossed channels, and the nucleon pole in the direct channel. The amplitudes P_{13} and P_{33}, derived in this way as functions of the CDD-pole term, are then compared with experiment by means of the calculated and experimental values of the scattering lengths a_{13} and a_{33}. It is shown, as one of the main results, that the low-energy P_{13} amplitude does not contain any CDD pole and produces a scattering length which is in excellent agreement with the experimental value, while the P_{33} amplitude necessarily contains a nonzero pole term. These results are in agreement with the conclusions made on the basis of a quite different approach—the "crankshaft analysis"—in the papers by Atkinson et al. (auth)

37266 EIKONAL REGGE MODEL FOR THE PROCESSES $\pi^\pm p \to A_1^\pm p$ AT SMALL MOMENTUM TRANSFERS. Ahmed, K. (Univ. of Islamabad, Rawalpindi, Pakistan); Bari, M. B.; Seth, V. P. Phys. Rev., D; 5: No. 7, 1701-8(1 Apr 1972).

An eikonal Regge representation is set up for the helicity amplitudes in the process $\pi p \to A_1 p$. These amplitudes are then used to calculate the density-matrix elements of $A_1(1^+)$, which are in agreement with the data. (auth)

37267 LIMITS ON THE RATE OF EMISSION OF NEGATIVE-ENERGY TACHYONS. Danburg, Jerome S.; Kalbfleisch, George R. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 5: No. 7, 1575-82(1 Apr 1972).

Since the proton is unstable against the tachyonic decay $p \rightarrow p + t^0$, in which the tachyon, t^0, has negative energy, the limits that can be imposed on such an apparently energy-nonconserving process, as well as on the related process, $p \rightarrow p + t + \bar{t}$, are investigated. Exceedingly long lifetimes for these decays (as well as the corresponding ones involving electrons) were obtained (a) from a careful examination of 5500 bubble-chamber pictures from a special exposure, (b) from reinterpretation of experiments searching for baryon and electron nonconservation, and (c) from data on the heat flow emanating from the earth. The interaction mediating such processes must be much weaker than the gravitational interaction. (auth)

37268 VECTOR-MESON PRODUCTION IN A MODEL OF HIGHER BARYON COUPLINGS. Sen Gupta, Krishna (Univ. of Delhi); Gupta, V. K. Phys. Rev., D; 5: No. 7, 1824-39(1 Apr 1972).

The phenomenological model for the couplings of hadron resonances (B_L) to the 56 baryons (B) and 36 mesons [pseudoscalar (P) or vector (V)], proposed by Mitra, is used for the investigation of certain $\pi + N \rightarrow V + N'$ reactions in the intermediate-energy region via the s channel, with the inclusion of baryon resonances with orbital angular momentum L = 0, 1, 2. The specific reactions considered are $\pi^{\pm}p \rightarrow \rho^{\pm}p$, $\pi^{-}p \rightarrow \rho^{0}n$, and $\pi^{+}n \rightarrow \omega p$. The results for differential cross sections and density matrices as functions of $\cos\theta$ are presented for each of the above reactions over a wide range of incident pion momentum (2.75–8 GeV/c). The structure of the PBB_L and VBB_L couplings for $L^P \rightarrow 0^+$ transition are characterized by a Lorentz-invariant form factor f_L, for which two different forms, also postulated by Mitra, are considered. For a comparison of the two form factors the $\pi^{+}p \rightarrow \rho^{+}p$ result are presented for both of them at all energies considered. The more recent (new) form factor gives a definitely better fit to the data than the earlier (old) one. A striking observation in this regard is that the old form factor predicts the wrong sign for $\mathrm{Re}\rho_{10}$, viz., positive in all cases, whereas the new form factor not only reverses the sign of $\mathrm{Re}\rho_{10}$ to bring it in agreement with experiment, but produces good agreement even in absolute value. As $\mathrm{Re}\rho_{10}$ is expected to depend much more crucially than other quantities on the relative phases and magnitudes of various partial amplitudes, the superiority of the new form factor over the old one is indicated. For the energy dependence, the agreement with experiment becomes consistently poorer at higher energies until at about 8-GeV/c lab momentum the two differ by an order of magnitude. This can perhaps be attributed to the neglect of higher resonances in the present calculation. The present calculation, which is done in the s channel, agrees well with other calculations performed in the t channel in the near forward direction as well as with the u-channel calculation in the near backward direction, thus providing a good case for duality. The conclusions drawn from the density-matrix analysis are qualitatively similar to those from the analysis of the differential cross section. (auth)

37269 ASYMMETRY OF THE PION DISTRIBUTION IN HIGH-ENERGY πp AND Kp INTERACTIONS. Suranyi, Peter (Univ. of Cincinnati). Phys. Rev., D.; 5: No. 7, 1871-2(1 Apr 1972).

The recently detected asymmetry of the c.m.-system momentum distribution of secondary pions in πp and Kp interactions is explained in the framework of the high-multiplicity approximation to multiperipheral-type models. (auth)

37270 AMPLITUDE ANALYSIS OF πN SCATTERING AT 6 GeV/c. Kelly, R. L. (Carnegie-Mellon Univ., Pittsburgh). Phys. Lett.; 39B: No. 5, 635-9(29 May 1972).

The amplitudes for πN scattering at 6 GeV/c were extracted from the available experimental data in the angular range $0 > t > -1.5$ $(\mathrm{GeV/c})^2$ using methods of analytic data analysis. The results for T = 0 exchange are consistent with s-channel helicity conservation at the 90% level, and indicate structure in the s-channel non-flip amplitude at small t. The T = 1 flip amplitude does not have the behavior characteristic of a nonsense wrong-signature zero at $t \approx -0.6$ $(\mathrm{GeV/c})^2$. The Fourier–Bessel transforms of the T = 1 amplitudes show strong evidence of non-peripherality, both at large and at small impact parameters. (auth)

37271 UNITARY BOUNDS FOR SPIN 0–SPIN $^1/_2$ SCATTERING. Hodgkinson, D. P. (Cavendish Lab., Cambridge, Eng.). Phys. Lett.; 39B: No. 5, 640-2(29 May 1972).

A bound is obtained for spin 0–spin $^1/_2$ scattering in terms of total and elastic cross sections and an integrated spin-rotation parameter, which improves the MacDowell–Martin bound. This new bound is violated by experimental data unless the integrated spin-rotation parameter is itself bounded. (auth)

37272 RADIATIVE CORRECTIONS TO PION–NUCLEON COUPLING CONSTANTS. Grossman, Z. (Tel-Aviv Univ., Israel); Preparata, G. Phys. Rev., D; 5: No. 8, 2069-77(15 Apr 1972).

A renormalization procedure is formulated for avoiding the problem of electromagnetic divergences in second-order electromagnetic amplitudes. It is applied to evaluate radiative corrections to pion-nucleon coupling constants. Such corrections are essentially divided into two categories: "low momentum" to ordinary minimal-coupling expressions and "tadpole" corrections originating from the high-momentum part of the photon integral. The first part is calculated using a Cottingham procedure, weak partial conservation of axial-vector current (PCAC), and saturation by low-lying intermediate states. The tadpole contribution is related to the analogous one in the case of electromagnetic mass shifts and is parametrized in terms of the ratio C_3/C_8 between tadpole-electromagnetic and medium-strong interactions and of the deviations from SU_3 symmetry for meson-baryon coupling constants. The corrections to the pion-nucleon coupling constants due to electromagnetic mass shifts are estimated separately. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 37413, 37542, and 37565.

37273 (ANL/HEP–7208(Vol.3), pp 1039-53) POSSIBLE pp EXPERIMENTAL PROGRAM FOR THE 12-FOOT CHAMBER. Kernan, W. J. Jr. (Iowa State Univ. of Science and Technology, Ames). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

A review is first given on the experimental status of multiparticle final states in pp interactions below 12 GeV in order to point out the need for further exploration in this region. Two types of bubble chamber experiments for studying pp interactions in the 12-ft chamber are then discussed: the study of multiparticle final states such as $p\pi\Delta$, $p\pi N^*$, $pp\rho^0$, $pp\omega^0$, and $pp\eta^0$; and the study of inclusive reactions. (L.B.S.)

37274 (COO–3001-8) TWO-PION EXCHANGE ΛN POTENTIAL. Riska, D. O. (State Univ. of New York, Stony Brook. Dept. of Physics). [1972]. Contract AT(11-1)-3001. 17p. Dep. NTIS.

The two-pion exchange contribution to the ΛN potential is calculated from the field theoretic scattering amplitude. The effect of the Adler consistency condition for the $\pi\Lambda$ and πN amplitudes is taken into account, as well as the s-wave $\pi\pi$ interaction. (auth)

37275 (ITF–71-105-P) DIFFRACTION OF NUCLEAR PROCESSES. Sitenko, A. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 31p. (In Russian). Dep. NTIS (U. S. Sales Only).

Experimental data on the hadron-nucleon scattering show that the hadron-nucleon interaction has a diffraction nature. Therefore the scattering of hadrons by nuclei at high energies can be described by analogy to an optical diffraction, i.e., it can be considered as a multifold diffraction scattering by separate nucleons. The diffraction approach allows the hadron-nuclear interaction amplitude to be expressed through the amplitude of scattering by separate nucleons and the form factors depending on the nuclear structure. Diffraction theory is in good agreement with numerous experimental data on the scattering of pions and nucleons by deuterons and other light nuclei and at present can serve as a basis for extracting information about the nuclear structure and hadron-nucleon interaction from experimental data on the hadron-nuclear interaction. (auth)

37276 (ITF–71-119-E) ON THE CHARACTER OF ASYMPTOTIC REGIME AND THE ROLE OF NUCLEONS IN THE HIGH-ENERGY HADRON COLLISIONS. Ginzburg, I. F. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 15p. Dep. NTIS (U. S. Sales Only).

On the grounds of the generalized multiperipheral model, it is shown that the main scattering characteristics should become asymptotic at $S \gtrsim 500\ \mathrm{GeV}^2$. The behavior of the diffraction cone slope, total cross sections, and multiplicity is discussed and from this view point. Effective violation of scaling for $H \lesssim 0.05$, a weak increase of the transverse momentum, and a rapid increase of multiplicity $n \approx 2, 5\ \ln S + \alpha$ at $S \gtrsim 500\ \mathrm{GeV}^2$ are predicated. Increase of the number of produced nucleons up to some asymptotic value is predicated in a more detailed model based on the γ^5-theory. (auth)

37277 (NP–19217) SUBPROGRAM FOR THE CALCULATION OF THE MATRIX ELEMENT OF SPIN ACCORDING TO THE ZEMACH METHOD. Note No. 328. Gaspero, Mario (Rome

Univ. (Italy). Istituto di Fisica. Istituto Nazionale di Fisica Nucleare, Rome (Italy)). 13 Jul 1971. 19p. (In Italian). Dep. NTIS (U. S. Sales Only).

The OXALIS Monte Carlo program for the study of the at rest annihilation $\bar{p}n \rightarrow 2\pi^+3\pi^-$ is described. This program has a subprogram for the calculation of the spin matrix elements in the Zemach relativistic form. This program is described, its characteristics are given, and the way in which it is used is discussed. (J.S.R.)

37278 SYMMETRIZATION EFFECTS IN SPECTATOR MOMENTUM DISTRIBUTIONS. Dean, N. W. (Iowa State Univ., Ames). Phys. Rev., D; 5: No. 7, 1661-6(1 Apr 1972).

The traditional identification of the slow nucleon as the spectator in deuteron-breakup collisions is shown to be valid only when there is a significant difference in the speeds of the two nucleons. When both have similar speeds, symmetrization effects cannot be ignored. These effects will be particularly important (a) for low-momentum-transfer events and (b) for "high-momentum spectator" events. A new comparison technique free of these difficulties is suggested. By studying the transverse momentum spectrum for both final-state nucleons, one avoids ambiguous spectator identification. In addition, the effect of the interference in such a distribution reveals the spatial symmetry of the final two-nucleon state. From this information it is possible to determine the relative contributions of spin-flip and -nonflip processes, and thereby to reconstruct the free-nucleon scattering accurately. (auth)

37279 PHENOMENOLOGICAL STUDY OF SINGLE-PARTICLE DISTRIBUTIONS NEAR THE KINEMATICAL LIMITS. Chen, Min-shih; Wang, Ling-lie; Wong, T. F. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 5: No. 7, 1667-73(1 Apr 1972).

A phenomenological analysis of the Regge-pole predictions for single-particle distributions from inclusive reactions of the type $a + b \rightarrow c$ + anything near the kinematical limits of the outgoing particle c. A prototype comparison with experimental data is made via a detailed analysis of the p, $\bar{p}$, π^+, π^-, K^+, and K^- distributions from inelastic pp scattering at 19.2 GeV/c and also some π^- distributions from pp scattering at 30 GeV/c. It is found that the distributions are not yet dominated by the known leading Regge poles. Some explanations are given. The prospects of this kind of study at higher machine energies are also discussed. (auth)

37280 QUANTITATIVE REGGE EXPRESSIONS WITH SCALING FOR EXPERIMENTALLY MEASURED FAST $\pi^\pm$, K^+ INCLUSIVE SPECTRA AND RELATION TO BACKWARD-ELASTIC-SCATTERING DATA. Risk, Clifford (Univ. of California, Berkeley. Univ. of California, Davis). Phys. Rev., D; 5: No. 7, 1685-95(1 Apr 1972).

The spectra for fast π^+, π^-, K^+ secondaries in pp collisions are represented in Reggeized forms that describe the experimental data measured at several energies and that scale at high energies. The inclusive amplitudes obtained are related to backward elastic $\pi^\pm p$, K^+p scattering and both their relative magnitudes and their energy and angle dependence are predicted. (auth)

37281 TWO-CHANNEL SEPARABLE ΛN POTENTIALS. Schick, L. H. (Univ. of Wyoming, Laramie); Tyagi, N. K. Phys. Rev., D; 5: No. 7, 1794-1801(1 Apr 1972).

An attempt is made to use a two-channel YN potential with a single nonlocal separable (NLS) form in each of the four potential matrix elements to represent the low-energy S-wave ΛN interaction. For each spin state equations are developed for expressing the Λ-channel, Σ-channel, and cross-channel potential strengths in terms of the values of the ΛN scattering length and effective range both for full and for no suppression of the Σ channel with general forms for the NLS potential shapes. The condition that there be no resonance due to a bound state in the uncoupled Σ channel is developed. The combined results are proposed as a method for determining which combinations of Λ-channel and Σ-channel NLS potential shapes may be eliminated as not capable of representing a meson-theoretic potential model of the low-energy ΛN interaction. Application of the results is made to the meson-theoretic potential of Brown, Downs, and Iddings. With Yamaguchi forms for both NLS shapes a $^1S_0$ resonance below the Σ-channel threshold due to an uncoupled Σ-channel bound state is always obtained. (auth)

37282 RESTRICTIONS ON TWO-CHANNEL SEPARABLE ΛN POTENTIALS. Damle, P. S.; Schick, L. H. (Univ. of Wyoming, Laramie). Phys. Rev., D; 5: No. 7, 1801-2(1 Apr 1972).

A previously suggested method for representing a meson-theoretic ΛN potential by a two-channel separable potential is shown to limit the shape of the separable Λ-channel potential for arbitrary shape of the separable Σ-channel potential. (auth)

37283 ELASTIC PION-DEUTERON SCATTERING IN THE PION-NUCLEON RESONANCE REGION. Wallace, Jon M. (Harvard Univ., Cambridge, Mass.). Phys. Rev., D; 5: No. 7, 1840-6 (1 Apr 1972).

Using nuclear multiple-scattering theory as a guide, generalizations of the Glauber formulas for pion-deutron elastic scattering are obtained which incorporate the internal motion of the nucleons in the deuteron. Application of our formulas at 766 MeV yields results in reasonable agreement with experiment. The incorporation of nuclear Fermi motion induces a smoothing of the momentum-transfer dependence of the differential cross section. (auth)

37284 ANALYSIS OF $np \rightarrow pp\pi^-$ REACTION ON THE VIEW OF A REGGEIZED OPE MODEL. Boreskov, K. G.; Gasparyan, A. P.; Kaidalov, A. B.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 3, 557-65(Mar 1972). (In Russian).

A theoretical processing of known experimental data on the $np \rightarrow pp\pi^-$ reaction in the 2- to 30-GeV energy region was made in the frame of a Reggeized OPE model. A mechanism of the $N^*(1470)\,{}^1\!/_2({}^1\!/_2{}^+)$ and $N^*(1690)\,{}^1\!/_2({}^5\!/_2{}^+)$ isobars diffraction production was shown to appear at energies $E_n > 4$ GeV in addition to a pion exchange and to contribute up to (30 to 40)% of the total reaction cross section. (auth)

37285 PHENOMENOLOGICAL STUDY OF INCLUSIVE SINGLE PARTICLE SPECTRA IN THE TRIPLE REGGE LIMIT. Ranft, G.; Ranft, I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 3, 566-71(Mar 1972). (In Russian).

Inclusive single particle spectra of $\pi^\pm$, $K^\pm$, p and $\bar{p}$ produced in pp collisions at 14.25, 19.2, 24 and 70 GeV/c are studied with the triple Regge formula. Good fits are obtained indicating that this formula describes well the s-, M*- and t-dependence of these data. The Regge parameters obtained in the fit differ however from the ones expected from the two-body reactions and change only slightly with increasing primary energy. (auth)

37286 ACCURACY OF GLAUBER APPROXIMATION IN INTERMEDIATE ENERGY REGION. Kolybasov, V. M.; Kondratyuk, L. A. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 39B: No. 4, 439-42(15 May 1972).

The effects of the recoil and rescattering of nucleons as well as the deviation from geometrical optics in elastic πd scattering at about 1 GeV are considered. The corresponding corrections to the Glauber formula are shown to compensate each other partially. (auth)

37287 ESTIMATION OF THE PRIMARY ENERGY OF VERY-HIGH-ENERGY NUCLEAR INTERACTIONS. Streitmatter, R. E.; Thompson, R. W. (Univ. of Chicago). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 135-41(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

The Castagnoli formula is generally used in order to estimate the energy of the primary particle in very high energy interactions. A detailed critical analysis of this method is given. (auth)

37288 INVESTIGATION OF THE NUCLEAR CASCADE PROCESS IN THE IONIZATION CALORIMETER. Akimov, V. N.; Fetisov, I. N.; Morozov, A. E.; Slavatinskii, S. A. (Lebedev Inst. of Physics, Moscow). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 231-5(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A new method for the consideration of some experimental strong interaction problems is discussed. This is a combination of analysis of experimental data obtained with an ionization calorimeter and the modelling of the calorimeter processes. A Monte-Carlo program is described. The calculated data on the total energy expended in nuclear disintegrations in a nuclear cascade are presented. (auth)

37289 PROPAGATION OF COSMIC RAYS IN THE ATMOSPHERE AND MODELS OF MULTIPLE MESON PRODUCTION. II. EXTENSIVE MONTE CARLO CALCULATION. Fujimoto, Y. (Waseda Univ., Tokyo); Hasegawa, S.; Kasahara, K.; (and others). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 311-19(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

A three-dimensional complete Monte Carlo simulation is carried out on the propagation of very high energy cosmic rays in the atmosphere. Large emulsion chambers are assumed as detectors. The H-quantum model and the two-fireball model are employed for multiple meson production. (auth)

37290 MONTE CARLO SIMULATION OF THE ATMOSPHERIC NUCLEAR CASCADE. Kondo, T.; Yamada, S.; Goto, E.; Koshiba, M. (Tokyo Univ.). Acta Phys. Acad. Sci. Hung.; 29: Suppl. 3, 555-62(1970).

From eleventh international conference on cosmic rays; Budapest, Hungary (25 Aug 1969).

Monte Carlo simulation of atmospheric nuclear cascade is made on the basis of the Aleph model of ultra high energy nuclear interactions, and its result is compared with the results based on other models. It is shown that the Aleph model gives a natural explanation to the existence of very high energy μ-bundles as well as to the observed energy spectra of atmospheric γ-rays. Other characteristics of the high energy cosmic radiation in the atmosphere are discussed. (auth)

37291 PHENOMENOLOGICAL MODEL FOR PION ABSORPTION. Pajares, C. (Univ., Madrid); Pascual, R. An. Fis.; 67: No. 9-10, 343-9(Sep-Oct 1971).

The phenomenological model of Eckstein is extended to absorption of p-wave pions by nuclei, and the value of the coupling constants is computed according to the present data on pion production in nucleon—nucleon scattering near threshold. (L.B.S.)

37292 ANGULAR DISTRIBUTIONS OF CHARGED PARTICLES BETWEEN 30^0 AND 90^0 PRODUCED IN pp COLLISIONS AT ISR ENERGIES. Breidenbach, M.; Charpak, G.; Coignet, G.; (and others) (CERN, Geneva. Institut fuer Experimentalphysik, Hamburg. Institut de Physique Nucleaire, Orsay, France. Institut fuer Hochenergiephysik, Vienna). Phys. Lett.; 39B: No. 5, 654-8(29 May 1972).

The angular distributions of charge particles produced in pp collisions at the CERN ISR were measured in the c.m. angular region from 30 to 90° at c.m. energies of 21.3, 30.4, 44.3, and 52.2 GeV. It is found that within this angular and energy range the c.m. differential cross sections vary as $\sin^{-2} \theta_{cm}$. The corresponding differential cross sections as a function of $\ln \tan \frac{1}{2} \theta_{cm}$ are flat between 0.0 and 1.3. The data indicate that the 90° cross sections increase by a factor of 2 between 6 and 53 GeV. (auth)

37293 ARE NEW PROTON—PROTON SCATTERING EXPERIMENTS NECESSARY BELOW 10 MeV. Slobodrian, R. J. (Univ. Laval, Quebec). Nuovo Cim.; 9A: No. 3, 340-8(1 Jun 1972).

Recent experimental results near 10 MeV obtained at Berkeley and Los Alamos are treated in terms of an energy-independent phase-shift analysis, complemented by an effective-range expansion analysis of the $^1S_0$ phase shifts. The one-pion-exchange dependence is confirmed but an anomaly is found near 10 MeV. The necessity and accuracy of further experimental work is indicated and discussed. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 37323 and 37795.

37294 INFINITE-DIMENSIONAL LIE ALGEBRA COMMON TO DUAL MODELS, CURRENT ALGEGRAS, DYNAMICAL GROUPS, AND GAUGE GROUPS. Barut, A. O.; Girardello, L.; Wyss, W. (Univ. of Colorado, Boulder). Lett. Nuovo Cim.; 4: No. 3, 100-4(20 May 1972).

The general infinite-dimensional Lie algebra and particular cases are first discussed. Some specific realizations are then given, followed by a discussion on the general mathematical framework of the algebra and the group. It is pointed out that the infinite-parameter Lie algebra should be further enlarged with the inclusion of spin and other internal quantum to form dynamic groups where current algebra and infinite-component wave equations are closely related, and which may provide a way to dual theories with spin. (L.B.S.)

37295 COMPUTER-GENERATED WEYL GROUPS. Beck, Robert E. (Villanova Univ., Pa.); Kolman, Bernard. Comput. Phys. Commun.; 3: No. 2, 155-8(Mar 1972).

The Program WEYL GROUP written in FORTRAN IV for the IBM 360/75 to generate the Weyl group of a complex simple Lie algebra and store in a high speed memory is described. (J.F.P.)

37296 CONFORMAL INVARIANCE IN PERTURBATION THEORY. Parisi, G. (CNEN, Frascati, Italy). Phys. Lett.; 39B: No. 5, 643-5(29 May 1972).

Asymptotic conformal invariance is proved to be true at all orders in perturbation theory. The correct Ward Identities for broken conformal invariance are derived: they are the extension of the Callan Symanzik equation from scale to conformal transformations. (auth)

37297 POINCARE NONINVARIANCE OF A RECENT ALTERNATIVE TO THE DIRAC EQUATION. Madan, R. N. (North Carolina A and T State Univ., Greensboro). Lett. Nuovo Cim.; 4: No. 2, 61-4(13 May 1972).

The infinitesimal generators of the Poincare group are explicitly constructed for the Stigman equation for spin one-half, finite mass particles. The Stigman equation is a first order, two-component equation and involves factorizing space—time-dependent matrices. It is found that the algebra of commutators closes only for the case of zero mass, thus the Sigman equation is not Poincare invariant except when the leptonic mass is zero. (L.B.S.)

37298 RANGE OF VALIDITY OF THE GELL-MANN FORMULA. Weimar, E. (Freie Univ., Berlin). Lett. Nuovo Cim.; 4: No. 2, 43-50(13 May 1972).

An attempt is made to find the sufficient and necessary conditions for those Lie algebras G with a symmetric subalgebra for which the Gell-Mann formula supplies a deformation of all irreducible representation of G. It is found that the validity of the Gell-Mann formula is restricted to the pseudo-orthogonal algebras only. (L.B.S.)

37299 INTEGRATION OF INFINITESIMAL TRANSFORMATIONS OF THE RELATIVISTIC QUASIEXCHANGE GROUP. Bogoslovskii, G. Yu. (Moscow State Univ.). Teor. Mat. Fiz.; 11: No. 2, 206-12(May 1972). (In Russian).

The finite transformations of the one-parameter group of relativistic quasiexchange are found with the aid of integrating nonlinear differential equations for infinitesimal transformations of the group. The elements of the quasiexchange group are the transformations of relative momenta q and p of three identical relativistic particles which leave invariant the equation of the energy surface: $E = \sqrt{p^2 + m^2} + \sqrt{p^2 + 4q^2 + 4m^2}$ and the element of the three-particle phase volume. The dependence of the obtained elements of the group on the parameter φ is determined by Jacobi elliptic functions. In nonrelativistic case they reduce to the usual trigonometric functions while the finite transformations reduce to linear representation of the corresponding subgroup of SO(6). (auth)

37300 DUAL N-POINT FUNCTIONS IN PGL(N-2,C)-INVARIANT FORMALISM. Hanson, Andrew J. (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., D; 5: No. 8, 1948-56(15 Apr 1972).

A new expression is derived for the dual N-point function integrand which is invariant under the action of the projective general linear group PGL(N−2, C). The $(N-1)(N-3)$ free complex parameters of the group are used to make the integrand independent of the values of $(N-1)$ points of complex dimension $(N-3)$ which appear in the integrand. These points uniquely specify the location of all $\frac{1}{2}(N-1)(N-2)$ hyperplanes which appear as branch singularities of the integrand when it is viewed as a function on $(N-3)$-dimensional complex projective space. In contrast to the Koba-Nielsen formalism, the PGL(N−2, C)-invariant form of the N-point integrand allows transformations which mix the $(N-3)$ integration variables and permits greater freedom in the placement of the branch singularities while preserving a simple hyperplane structure for the singularities. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 37223.

37301 (ANL/HEP-7208(Vol.1), pp 349-63) PARITY-VIOLATING EFFECTS IN NUCLEI: A SURVEY OF THE PRESENT STATUS. Segel, Ralph E. (Argonne National Lab., Ill. Northwestern Univ., Evanston, Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Recent experiments yielding important results on parity nonconservation in nuclei are discussed. A 1.5% asymmetry reported in the decay of ^{180}Hf* nuclei provides the most convincing evidence to date for the presence of parity-violating nuclear forces. However, it is shown that the nuclear-structure effects in this case appear to preclude the drawing of detailed theoretical conclusions. The parity-forbidden alpha decay of the 8.87-MeV state in ^{16}O is much more susceptible to theoretical interpretation. The present status of the experiments that are measuring the rate of this transition are discussed. Some other experiments that have been done and/or are contemplated are commented upon. (auth)

37302 IS THE $\epsilon(700)$ MESON THE GOLDSTONE BOSON OF BROKEN SCALE INVARIANCE? Renner, B. (Univ., Hamburg); Staunton, L. P. Phys. Rev., D; 5: No. 7, 1676-80(1 Apr 1972).

Low-energy theorems of broken scale invariance are examined, using for tests phenomenological $(\pi\pi)$ phase shifts and thus improving on the usual pole approximation for the $\epsilon(700)$ meson, commonly assumed to act as a Goldstone boson. Approximate consistency is found for a model based on broken $SU_3 \times SU_3$ symmetry, provided that a certain subtraction constant, already present on the level of pole models, is used as a free parameter to be fitted by the data. Yet there are definite indications that contrary to the role of the pion in broken chiral symmetry, broken scale invariance cannot be understood in terms of the $\epsilon(700)$ meson alone and contributions from higher states are needed in an essential manner. (auth)

37303 LEPTON-NUMBER AND CHIRALITY NONCONSERVATION IN WEAK PROCESSES. Primakoff, H. (Univ. of Pennsylvania, Philadelphia); Rosen, S. P. Phys. Rev., D; 5: No. 7, 1784-93(1 Apr 1972).

A description of leptonic and semileptonic weak processes is proposed which involves the use of only three distinct lepton field operators $\psi_{e^-}(x)$, $\psi_{\mu^-}(x)$, and $\psi_\nu(x)$ and postulates such an expression for the leptonic weak current $l'_\alpha(\psi_{e^-}(x), \psi_{\mu^-}(x), \psi_\nu(x))$ that (1) neither the conservation of total lepton number nor the "conservation of neutrino chirality" holds exactly, and (2) the extent of lepton-number nonconservation and neutrino-chirality nonconservation becomes maximal at high interlepton momentum transfers. As a result, various weak processes forbidden in the conventional description and so far unobserved at relatively small momentum transfers are expected to proceed with non-negligible rates at higher momentum transfers. A discussion is given of certain of these processes and particular attention is focused on the production processes $\nu_\mu + p \rightarrow e^+ + n$, $\nu_\mu + p \rightarrow e^- + \Delta^{++}$, $\nu_\mu + p \rightarrow \mu^+ + n$, and $\nu_\mu + (Z,A) \rightarrow e^- + \mu^+ + \nu_\mu + (Z,A)$, and on the decay processes $K^+ \rightarrow \mu^+ + e^+ + \pi^-$ and $\mu^+ \rightarrow e^+ + \gamma$. (auth)

37304 BROKEN SYMMETRY IN THE K^0-MESON THEORY AND GOLDSTONE THEOREM. Grib, A. A.; Mostepanenko, V. M. (Leningrad State Univ.). Yadern. Fiz.; 15: No. 3, 523-9(Mar 1972). (In Russian).

A model of SU(2) and CP-symmetries breaking in the K^0-meson theory is constructed. Symmetry breaking is carried out in two stages: on the spontaneous breaking additional nonspontaneous one is imposed which is caused by the weak interactions. The impossibility is proved of the purely spontaneous CP-breaking in the present model. The results are examined to which the Glashow—Weinberg modification of the Goldstone theorem leads; the properties of the Goldstone bosons are determined. The model is shown to lead to the phenomenological "milliweak" CP-breaking. Possible differences from the phenomenological scheme are discussed. (auth)

37305 K_{13} DECAYS AND CHIRAL SYMMETRY BREAKING. Magradze, B. A.; Tsugulea, M. N.; Eliashvili, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 3, 530-3(Mar 1972). (In Russian).

An effective Lagrangian model with $SU(3) \times SU(3)$ symmetry breaking terms being transformed as $(3,3^*) + (3^*,3)$ and $(1,8) + (8,1)$ representations was considered. Such a model was shown to give a reasonable description of the K_{13} form factors. (auth)

37306 MEASUREMENT OF $|\eta_{00}|/|\eta_{+-}|$. Banner, M.; Cronin, J. W.; Hoffman, C. M.; Knapp, B. C.; Shochet, M. J. (Princeton Univ., N. J.). Phys. Rev. Lett.; 28: No. 24, 1597-1601(12 Jun 1972).

The quantity $|\eta_{00}|/|\eta_{+-}|$ was measured, which is defined in terms of K_L and K_S decay rates by the ratio $[\Gamma(K_L \rightarrow \pi^0\pi^0)\Gamma(K_S \rightarrow \pi^+\pi^-)/\Gamma(K_L \rightarrow \pi^+\pi^-)\Gamma(K_S \rightarrow \pi^0\pi^0)]^{1/2}$. $|\eta_{00}|/|\eta_{+-}| = 1.03 \pm 0.07$ was found. (auth)

37307 MIXING ANGLE IN RENORMALIZABLE THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Weinberg, Steven (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 5: No. 8, 1962-7(15 Apr 1972).

It is suggested that the weak and electromagnetic interactions be incorporated into a theory based on an $SU(3) \otimes SU(3)$ gauge-invariant and parity-conserving Lagrangian, in which the lepton fields form a Konopinski-Mahmoud triplet μ^+, ν, e^-. The unobserved effects which would be produced by 10 of the 12 charged vector bosons in this theory are suppressed if the spontaneous breaking of $SU(3) \otimes SU(3)$ down to $SU(2) \otimes U(1)$ is much stronger than the spontaneous breaking of $SU(2) \otimes U(1)$ down to electromagnetic gauge invariance. The resulting theory is for most purposes equivalent to the previous $SU(2) \otimes U(1)$ model, but with mixing angle now fixed at 30°. In consequence, the mass of the charged vector boson which mediates the known weak interactions is now predicted to be 74.6 GeV. This model also provides a natural mechanism for producing an electron mass of order αm_μ. (auth)

37308 EFFECT OF WEIGHTED LINEAR TRANSFORMATIONS ON CHIRAL $SU_3 \otimes SU_3$ MASS BREAKING. Rest, J.; Welling, D. J. (Univ. of Wisconsin, Milwaukee). Phys. Rev., D; 5: No. 8, 1983-6(15 Apr 1972).

An extension of an earlier work is presented where octet breaking in SU_3 symmetry was used together with a "weighted" linear transformation for the physical fields to determine the effect of symmetry breaking by mass splitting on the K_{13} form factors. Generalization is made to chiral $SU_3 \otimes SU_3$ and the relationships between the "weighted" linear transformations, the form of intrinsic symmetry breaking, and the physical-mass rules are examined. It is realized that the transformation properties of the physical Hamiltonian do differ from a simple $(3,3^*) \oplus (3^*,3)$ form. Consistent physical-mass sum rules are derived between the scalar and pseudoscalar particles. (auth)

Applications (Strong)

37309 MESON LADDER OF THE U(6,6)-SYMMETRY. Drenska, S. (Inst. of Physics, Sofia); Ivanov, M.; Vaklev, J.; Nikolov, A. Ann. Phys. (N. Y.); 70: No. 2, 399-411(Apr 1972).

A unified classification of the mesons is made with the help of the so-called meson ladder of U(6,6). For this reason a complete set of commuting operators, including the squares of the spin, of the isotopic spin, their third projections, the hypercharge, the baryon number and so on is introduced. Multiplets from a non-traditional type are obtained, which are in a good agreement with the experimental situation (among them are, for instance, the Schwinger nonets with spin parity 0^-, 1^-, 2^+). There is introduced also a mass operator which is diagonal in the particles. With its help series of mass formulas are obtained for mesons with spin parity 0^-, 1^-, 0^+, 1^+, 2^+ and they are in very good agreement with the experiment. (auth)

37310 TEST OF SCALE INVARIANCE IN PION PRODUCTION AT HIGH ENERGIES USING COSMIC RAY PRIMARY NUCLEON AND SEA LEVEL MUON INTENSITIES. Murthy, P. V. Ramana; Subramanian, A. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 39B: No. 5, 646-8(29 May 1972).

An analysis made using the ratio of intensities of the cosmic ray nucleons at the top of the atmosphere and muons at sea level indicates the validity of the hypothesis of Feynman regarding scale invariance in particle production in the energy region 50 GeV to 2×10^4 GeV. (auth)

37311 BROKEN CHIRAL SYMMETRIES AND THE HOLONOMY GROUP. Volkov, D. V. (Physical-Technical Inst., Kharkov). Teor. Mat. Fiz.; 11: No. 2, 173-81(May 1972). (In Russian).

The restrictions on the chiral symmetry breaking in the quasi-kinetic part of the phenomenological meson Lagrangian are considered under the supposition that the symmetry breaking does not change the holonomy group. (auth)

Field Theories

General

37312 NUCLEAR REPULSIVE-CORE EFFECT AS A POSSIBLE CONSEQUENCE OF MATTER IN INTERACTION WITH A CLASSICAL RELATIVISTIC SCALAR FIELD: A NEW APPROACH TO THE QUESTION. Leiter, D. (Univ. of Windsor, Ont.); Huschilt, J.; Szamosi, G. Can. J. Phys.; 50: No. 7, 636-45(1 Apr 1972).

The N-body problem is analyzed within the framework of a new formalism for relativistic point masses interacting via a scalar field, in which the problems of infinite self-energies are absent. A Lagrangian formalism is exhibited which yields the particle equations of motion in the form of a parameterized class of equations. The parameter determines the choice of boundary conditions which is chosen on the scalar-field equations. The existence or nonexistence of the relativistic nuclear hard-core effect, associated with the scalar-field interactions, is shown to depend critically on the particular set of boundary conditions which are imposed on the scalar-field equations. In particular, time-symmetric boundary conditions yield no hard-core repulsion, while retarded boundary conditions are shown to yield a hard-core repulsion at very short range. (auth)

Quantum Field Theory

37313 (ITF-71-131-E) INVARIANT REGULARIZATION OF GAUGE THEORIES. Slavnov, A. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 9p. Dep. NTIS (U. S. Sales Only).

The general method of invariant regularization of gauge theories is constructed. Renormalizability of the massless Yang–Mills theory and self-consistency of the Ward identities derived earlier are proved. (auth)

37314 (NYO–3829-90) ASYMPTOTIC SCALE INVARIANCE IN A MASSIVE THIRRING MODEL. Gomes, M.; Lowenstein, J. H. (Pittsburgh Univ., Pa. Dept. of Physics). Feb 1972. Contract AT(30-1)-3829. 20p. Dep. NTIS.

The absence of Callan–Symanzik coupling-constant renormalization in a massive Thirring model is demonstrated to all orders using normal product methods. The derivation depends crucially on the mildness of the "anomaly" of the axial-vector Ward identity in this model, as well as on the special relation between vector and axial-vector currents in two-dimensional field theory. Application of power-counting arguments establishes the asymptotic scale invariance of the vertex functions when the mass m tends to zero with the normalization point μ either fixed (Gell–Mann–Low limit) or vanishing with m (Callan–Symanzik limit). (auth)

37315 POSITIVE-ENERGY RELATIVISTIC WAVE EQUATION. II. Dirac, P. A. M. (Florida State Univ., Tallahassee). Proc. Roy. Soc. (London), Ser. A; 328: No. 1572, 1-7(2 May 1972).

The wave equation proposed in Proc. Roy. Soc. A 322: 435(1971) is examined from the point of view of the Heisenberg picture, for the purpose of obtaining a physical model. It is found that the position of the particle can roam about over a spherical shell under the influence of a kind of gauge transformation. With the passage of time the shell pulsates. The coordinates of the center of the shell do not commute. These coordinates provide a reference point for defining orbital angular momentum which leads to zero spin for all momentum values. (auth)

37316 ANGULAR MOMENTUM LAW IN SPECIAL RELATIVITY. Strnad, J. (Univ., Ljubljana, Yugoslavia. Jozef Stefan Nuclear Inst., Ljubljana, Yugoslavia). Fizika (Zagreb); 4: No. 2, 137-40(Apr 1972).

It is pointed out that in special relativity the angular momentum law cannot be formulated in a familiar form for a moving pivot. (L.B.S.)

37317 WARD IDENTITIES AND TRACE IDENTITIES FOR THE STRESS-ENERGY TENSOR. Rouet, A.; Stora, R. (CNRS, Marseille). Lett. Nuovo Cim.; 4: No. 4, 136-8(27 May 1972).

It is shown that a family of stress energy operators whose Green's functions fulfill Ward identities can be constructed by application of Noether's theorem to an effective Lagrangian within the framework of Zimmermann's method. (L.B.S.)

37318 NOETHER'S THEOREM AND WARD IDENTITIES IN RENORMALIZABLE THEORIES. Rouet, A.; Stora, R. (CNRS, Marseille). Lett. Nuovo Cim.; 4: No. 4, 139-40(27 May 1972).

Ward identities associated with space-time symmetries were previously exhibited in the general case of renormalizable field theories. The main features of these identities, in their relationship with the application of Noethers theorem to the effective Lagrangian, are pointed out. (L.B.S.)

37319 COMMENT ON A RECENT PAPER OF OLKHOVSKII AND RECAMI. Ramachandran, G.; Tagare, S. G.; Kolaskar, A. S. (Indian Inst. of Science, Bangalore). Lett. Nuovo Cim.; 4: No. 4, 141-3(27 May 1972).

It was suggested by Olkhovskii and Recami (Lett. Nuovo Cimento, 1: 165 (1971)) that inertial frames of reference with relative velocities greater than c could be introduced into the framework of special theory of relativity if space-time is considered to be complex quantities. It is pointed out that the authors do not make clear their definition of velocity in complex space-time and that this possibility cannot be realized in such a simple way. (L.B.S.)

37320 MORE ABOUT LORENTZ TRANSFORMATIONS AND TACHYONS: ANSWER TO THE COMMENTS BY RAMACHANDRAN, TAGARE, AND KOLASKAR. Recami, E. (Univ., Catania, Italy. Istituto Nazionale di Fisica Nucleare, Catania, Italy. Centro Siciliano di Fisica Nucleare e di Struttura della Materia, Catania, Italy); Mignani, R. Lett. Nuovo Cim.; 4: No. 4, 144-52 (27 May 1972).

Clarifications are made on a previous letter about Lorentz transformations and tachyons (Lett. Nuovo Cimento, 1: 165(1971)). (L.B.S.)

37321 SHADOW OPERATOR FORMALISM FOR CONFORMAL ALGEBRA. VACUUM EXPECTATION VALUES AND OPERATOR PRODUCTS. Ferrara, S. (CNEN, Frascati, Italy); Grillo, A. F.; Parisi, G.; Gatto, R. Lett. Nuovo Cim.; 4: No. 4, 115-20(27 May 1972).

A set of general properties of conformal covariant theories is presented. The formalism is entirely formulated in space-time and the requirement of conformal invariance is achieved by adding to the Poincare algebra plus dilatation a nonlinear discrete operation, called co-ordinate inversion R. The two-point correlation function for any local tensor operator is shown to be strictly related to the matrix transformation of the local operator under the action of R. A projection operator formalism is derived, which enables the constraints of full conformal covariance on the operator-product expansion of any two tensors to be solved in a closed form. (L.B.S.)

37322 YUKAWA QUANTUM FIELD THEORY IN TWO SPACE–TIME DIMENSIONS WITHOUT CUTOFFS. Schrader, Robert (Harvard Univ., Cambridge, Mass.). Ann. Phys. (N. Y.); 70: No. 2, 412-57(Apr 1972).

Estimates are provided that permit the construction of the physical vacuum and the corresponding Hilbert space of the Y_2 theory. The representation of the local field algebra thus obtained is locally Fock. One estimate is a volume-dependent first-order N_τ estimate, which implies in particular that the vacuum energy per unit volume is bounded from below. The second estimate states that the vacuum energy per unit volume is bounded from above. (auth)

37323 ALGEBRAIC IDENTITIES FOR PARAFERMI STATISTICS OF GIVEN ORDER. Bracken, A. J.; Green, H. S. (Univ. of Adelaide). Nuovo Cim.; 9A: No. 3, 349-65(1 Jun 1972).

It is pointed out that the structure of parafermion algebras generated by N pairs of creation and annihilation operators is determined by the unique occurrence of certain representations of U_N in particular representations of SO_{2N} and SO_{2N+1}, identified by the eigenvalues of their invariants. This observation is used to derive a variety of identities satisfied by the creation and annihilation operators, which are characteristic of the order p of the parastatistics. The "statistical quantrum number" of Ohnuki and Kamefuchi is identified with the invariant of SO_{2N} and related in turn to the invariants of U_N. A simple method is stated for the systematic determination of special identities, some of which are already known. (auth)

37324 FALSE POLE IN THE PHOTON GREEN FUNCTION. Kirzhnits, D. A.; Kryuchkov, G. Yu. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 11: No. 2, 152-61(May 1972). (In Russian).

The results of applying the differential by the coupling constant method to the theory of boson-fermion three-particle interaction and, in particular, to quantum electrodynamics, are discussed. The expression for the photon Green function is obtained, which possesses the correct analytical properties in any finite part of the complex plane of energy and squared momentum, has nonanalytical dependence on the coupling constant and coincides with the usual solution if expanded in the perturbation theory series. (auth)

37325 CONVERGENCE OF PERTURBATION SERIES FOR THE FIELD THEORY MODELS CONTAINING FERMIONS. Ivanov, S. S.; Rebenko, A. L. (Inst. of Theoretical Physics, Kiev). Teor. Mat. Fiz.; 11: No. 2, 190-202(May 1972). (In Russian).

The problem of convergence of the perturbation series in the Euclidean region of the momenta for the field theory models containing fermions is investigated. Some estimates are presented which characterize a possible rapidity of divergence under removing the cutoff. Nonlocal variant of the theory is briefly investigated. (auth)

37326 PROBLEM OF THE ANOMALOUS ORIGIN OF MASSES. I. Vasil'ev, A. N. (Leningrad State Univ.). Teor. Mat. Fiz.; 11: No. 2, 137-51(May 1972). (In Russian).

The dependence of the vacuum energy density ϵ on the bare masses and coupling constants is studied. The form of the dependence of ϵ on the mass provides indirect information on the possibility (or impossibility) of spontaneous production of the mass in the originally massless theory: the spontaneous production of the mass takes place only if it is "energetically profitable", i.e., if the vacuum energy density decreases with the increasing of the mass. The model of the unified weak and electromagnetic interaction of leptons with intermediate bosons, in which all the bare masses are equal to zero, is discussed. In this work is shown that the photon is stable with the respect to the spontaneous production of the mass. As a by-product it is shown that the second derivative of ϵ with respect to any coupling constant ("any" refers to the case when the interaction contains several terms) is negative, i.e., the corresponding curve is convex in the upper direction. It is shown also that "bad" scalar theories ($\lambda\varphi^3$, $\lambda\varphi^4$, with $\lambda > 0$) are stable with respect to the spontaneous mass production. (auth)

37327 MASS DIVERGENCES AND CALLAN–SYMANZIK EQUATIONS IN QUANTUM ELECTRODYNAMICS. Sirlin, A. (New York Univ., N. Y.). Phys. Rev., D; 5: No. 8, 2132-4(15 Apr 1972).

The connection between the theorems on mass divergences of unrenormalized (but regularized) vertex functions and the asymptotic Callan–Symanzik equations in quantum electrodynamics is discussed. To illustrate the point, these theorems are first used to give a rather simple derivation of the asymptotic Callan–Symanzik equation for the renormalized photon propagator and later the analysis is generalized to the 2n + 1 vertex function. By a natural extension of the argument, one obtains nonasymptotic equations in which the inhomogeneous terms involve mass derivatives of the unrenormalized vertex functions multiplied by suitable products of the renormalization constants Z_2 and Z_3. As a by-product, one obtains partial differential equations for Z_2 and Z_3 regarded as functions of the masses. The method can be used when several internal masses are present in the problem, in either the conventional or the intermediate renormalization schemes. (auth)

37328 COVARIANT FORMULATION OF THE COMPLEX-GHOST RELATIVISTIC FIELD THEORY AND THE LORENTZ NONINVARIANCE OF THE S MATRIX. Nakanishi, Noboru (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., D; 5: No. 8, 1968-75(15 Apr 1972).

The complex-ghost relativistic field theory with real spatial momenta is formulated in a formally covariant way. The free spinless complex-ghost field operator is shown to be a Lorentz scalar. The Lee–Wick complex contour in the Feynman propagator is derived without recourse to the definition of the S matrix. The Feynman-Dyson form of the S matrix is obtained by introducing an adiabatic factor of the Gaussian type. In order to have a finite result in the limit of no adiabatic factor, a reasonable mathematical device is introduced, and the reason why the S matrix becomes Lorentz-noninvariant in spite of its formal invariance is clarified. The S matrix thus obtained is shown to be equivalent to the S matrix defined noncovariantly by Lee and Wick. (auth)

37329 NONPLANAR HELICITY-POLE COUPLINGS: DUALITY AND THE FEYNMAN GRAPH. I. Gordon, David (National Accelerator Lab., Batavia, Ill.). Phys. Rev., D; 5: No. 8, 2102-15 (15 Apr 1972).

A study is made, in the spirit of Gribov's Reggeon calculus, of a particular nonplanar elastic six-point amplitude which contributes to the helicity-pole limit (s, $M^2 \to \infty$, $s/M^2 \to \infty$, and t fixed) of the single-particle distribution. "Third double-spectral function" effects analogous to those which appear in 2-2 amplitudes are found. In particular (1) nonsense–triple-Regge–wrong-signature fixed poles are found, and (2) the triple-Pomeranchukon vertex is found to be finite at $t = 0$ if the slope of the trajectory is nonzero and its intercept unity. In addition, an asymptotic link between the high-energy Regge limits of ϕ^3 theory amplitudes and the high-energy Regge behavior of dual-tree and dual-loop amplitudes is conjectured. (auth)

37330 NONPLANAR COUPLINGS IN THE TRIPLE-REGGE VERTEX. Mueller, A. H. (New York Univ., N. Y. Brookhaven National Lab., Upton, N. Y.); Trueman, T. L. Phys. Rev., D; 5: No. 8, 2115-23(15 Apr 1972).

Recently zeros have been found at $\alpha_V(0) = 2\alpha(t) - 1$, $2\alpha(t) - 2, \ldots$ in the triple-Regge vertex involving $\alpha_V(0) - \alpha(t) - \alpha(t)$. Such zeros were found both in a dual-resonance model and in certain classes of Feynman graphs. This question is examined in a model of nonplanar Feynman graphs and found zeros at $\alpha_V(0) = 2\alpha(t) - 2$, $2\alpha(t) - 4, \ldots$ but not at $\alpha_V(0) = 2\alpha(t) - 1$, $2\alpha(t) - 3, \ldots$. In particular, the zero involving the triple-Pomeranchukon coupling at $t = 0$ is not present. (auth)

Gravitation and General Relativity

Refer also to abstracts 36840 and 37795.

37331 (ITF-71-113-P) SOME QUESTIONS OF QUALITATIVE THEORY OF GEODESIC LINES IN THE FIELD OF GRAVITATING CENTER. Piragas, K. A.; Krivenko, O. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 26p. (In Russian). Dep. NTIS (U. S. Sales Only).

Qualitative integration of the equations of geodesic lines in the fields of charged and uncharged centers in general relativity is given. In particular, it is shown that in the Schwarzschild field, any circular orbit whose radius r satisfies the condition $1.5\ r_0 < r < 3\ r_0$, where r_0 is the gravitational radius of a body, is the limiting Poincaré cycle. (auth)

37332 QUANTIZATION OF MASSIVE GRAVITATION. Tyutin, I. V.; Fradkin, E. S. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 15: No. 3, 597-604(Mar 1972). (In Russian).

The question is analyzed of a canonical quantization of a massive gravitational field theory and of a construction of a suitable generating functional (of Feynman diagrams rules). The auxiliary diagrams typical for nonlinear derivative interaction models appear in the theory. Parameters of the coordinate gauge transformations are interpreted as a quantized field that appears may be identified as an electromagnetic field. (auth)

37333 CLOSED COSMOLOGICAL SOLUTIONS TO EINSTEIN'S FIELD EQUATIONS. Rauscher, E. A. (Univ. of California, Berkeley). Lett. Nuovo Cim.; 3: No. 16, 661-5(15 Apr 1972).

A prescription made for geometrizing the space-time manifold as an extension of Wheeler's Wormhole theory is presented. In this method a set of variables called quantal units is introduced into the cosmological equations which are considered to act as an additional constraint and which make implications about possible closed cosmological solutions. An idealized universe that is isotropic and homogeneous is considered. (J.F.P.)

37334 RIGID NONROTATIONAL MOTION IN A TWO-DIMENSIONAL SPACE. I. Evtushenko, S. P. Gravitatsiya Teor. Otnositel'nosti; No. 7, 34-7(1970). (In Russian).

A natural generalization of the concept of motion of a body as an absolutely solid state to the relativistic case is motion for which the orthogonal interval between the world lines of two close points of the body is preserved. This condition is expressed by a differential equation for 4-velocity of a fixed point of the body. By using this equation for the nonrotational case, it is shown that at every point of the world line it is possible to construct a unit vector frame with a time unit vector along the world line such that the unit vectors of each of the three spatial unit vectors of the frame will define a set of geodetic 4-velocity vectors orthogonal to the field. It is shown that in a two-dimensional space-time all three sets will be in a single-parametric set of hyperplanes. (JPRS)

37335 STUDY OF BORN EQUATIONS OF RIGID MOTION IN A TWO-DIMENSIONAL SPACE. II. Evtushenko, S. P. Gravitatsiya Teor. Otnositel'nosti; No. 7, 38-41(1970). (In Russian).

After investigating the differential equation of motion of points of a rigid (in the Born sense) body $A_{\alpha\beta} \equiv u_{\alpha;\beta} + u_\beta u^\alpha u_{\alpha;\alpha} + u_{\beta;\alpha} + u_\alpha u^\sigma u_{\beta;\sigma} = 0$, where $u^\alpha = dx^\alpha/ds$ is a 4-velocity field, it is shown that in the two-dimensional space-time the equations with identical indexes $\alpha = \beta$ are corollaries of equations with different indexes $\alpha \neq \beta$. When $\alpha \neq \beta$, the general solution of this equation has the form: $u_\alpha/u_\beta = \psi_{\alpha\beta}(x^\alpha + x^\beta u_\beta/u_\alpha, x^\tau, x^\delta)$ (1) where summation with respect to α, β does not occur; α, β, τ, δ are not equal to each other; and $\psi_{\alpha\beta}$ satisfies the algebraic conditions $\psi_{\alpha\beta} = (\psi_{\beta\alpha})^{-1}$, $\psi_{\alpha\gamma}/\psi_{\beta\gamma}$. Thus, the problem of finding rigid motion is reduced in the general case to the solution of finite equations (1) with respect to u_α. (JPRS)

37336 GENERAL-RELATIVISTIC INTERIOR METRIC FOR A STABLE STATIC CHARGED MATTER FLUID WITH LARGE e/m. Bailyn, M.; Eimerl, D. (Northwestern Univ., Evanston, Ill.). Phys. Rev., D; 5: No. 8, 1897-1907(15 Apr 1972).

The general-relativistic field equations are solved for a spherically symmetric static charged matter fluid in isotropic coordinates, and matched at the boundary R to the external Reissner-Nordström metric. No pressure, i.e., stress of undefined origin, is involved. There turns out to be one more unknown than equation, but consistency and continuity conditions severely restrict the solutions. It is found that the charged fluid can be in equilibrium even with a large e/m, such as for an electron considered as a fluid, but only if (1) there is a singularity in g_{44} at $r = 0$, (2) the matter density ρ_m in the energy-momentum tensor is negative, and (3) the ratio ρ_e/ρ_m of charge to matter density is a variable function. The energy density (as opposed to the matter density) can be made everywhere positive in the coordinates used. A simple picture of how the forces balance can be made. (auth)

37337 MOTION OF PARTICLES IN EINSTEIN'S RELATIVISTIC FIELD THEORY. V. GRAVITATION AND THE LORENTZ-

COVARIANT PROCEDURE. Johnson, Coates R. (Univ. of Georgia, Athens). Phys. Rev., D; 5: No. 8, 1916-25(15 Apr 1972).

In several earlier papers an approximation method was developed for finding the Lorentz-covariant equations of structure and motion of interacting particles (represented by singularities) in Einstein's theory of the nonsymmetric field. In these earlier papers two specific procedures were suggested for investigating a particular form of partial differential equation which appears when carrying out the approximation method. One of these two specific procedures was Lorentz-covariant at each stage of the analysis and one was not. In both cases the final result was Lorentz-covariant. In the earlier papers, when applying the approximation method to specific particles, only the noncovariant procedure was used. The use of the Lorentz-covariant procedure is illustrated by applying this procedure up to fourth order to the case of interacting simple neutral particles—particles which interact only through the gravitational field. (auth)

37338 APPLICATION OF REGGE CALCULUS TO THE AXIALLY SYMMETRIC INITIAL-VALUE PROBLEM IN GENERAL RELATIVITY. Collins, P. A.; Williams, Ruth M. (Imperial Coll. of Science and Tech., London). Phys. Rev., D; 5: No. 8, 1908-12(15 Apr 1972).

Using Regge calculus some axially symmetric solutions of the initial-value equations of general relativity are constructed at the moment of time symmetry. Examples of infinite and closed spaces are given. (auth)

37339 SOLUTION OF THE SCALAR WAVE EQUATION IN A KERR BACKGROUND BY SEPARATION OF VARIABLES. Brill, Dieter R. (Univ. of Maryland, College Park); Chrzanowski, Paul L.; Pereira, C. Martin; Fackerell, Edward D.; Ipser, James R. Phys. Rev., D; 5: No. 8, 1913-15(15 Apr 1972).

The effect of the Kerr gravitational field on wave phenomena is explored by examining the inhomogeneous wave equation for a scalar massive field in a Kerr background geometry. The equation is separated in Boyer—Lindquist coordinates. The angular functions are spheroidal harmonics, and the radial equation is reduced to a one-dimensional Schrödinger equation with an effective potential. (auth)

Scattering Theory

Refer also to abstracts 36203 and 37245.

37340 (ANL/HEP—7208(Vol.3), pp 1146) PHENOMENOLOGY OF COMPLEX POLES. Ball, James S. (Utah Univ., Salt Lake City). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

The use of complex Regge poles to represent important Regge cuts in scattering amplitudes is suggested. It is pointed out that complex poles provide a reasonable basis for high energy phenomenology, and have sufficient flexibility to fit the data. (L.B.S.)

37341 (ITF—71-106-E) THREE-DIMENSIONAL INVERSE PROBLEM IN THE QUANTUM THEORY OF SCATTERING. Faddeev, L. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 28p. Dep. NTIS (U. S. Sales Only).

The well known approach to the inverse problem of scattering theory, based on the Gelfand—Levitan integral equation, or the Marchenko equation is generalized from the case of the one-dimensional problem to the case of the three-dimensional problem. (auth)

37342 (ORO—4317-5) ANGULAR-MOMENTUM DECOMPOSITION OF THE FADDEEV—LOVELACE EQUATIONS. Technical Report No. 72-095. Lavine, J. P. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Apr 1972. 16p. Dep. NTIS.

An angular-momentum decomposition is presented for the Faddeev—Lovelace formulation of the three-body problem. The result is a coupled system of integral equations with two continuous variables. In contrast with previously published decompositions, the limits of integration in the integral term are independent of the integration variables, thus simplifying the numerical problem for nonseparable potentials. Explicit equations are given for the case in which only two-body s-wave interactions and relative s-states are allowed. (auth)

37343 BIAS-FREE METHOD FOR THE DETECTION OF BOUND, ANTIBOUND, AND RESONANT STATES FROM ERROR-AFFECTED EXPERIMENTAL DATA. Caprini, I.; Ciulli, S.; Pomponiu, A.; Sabba-Stefanescu, I. (Inst. for Atomic Physics, Bucharest). Phys. Rev., D; 5: No. 7, 1658-61(1 Apr 1972).

It has already been recognized that if the scattering amplitude is known only along a limited part of the cuts and with a limited accuracy, its analytic continuation to other points of its domain of holomorphy is not only nonunique but also unstable. The latter is a crucial fact both for the phenomenological analyses and for the theory unless we are in the fortunate position to have a theory which predicts the amplitude at all energies at once. Indeed, as a consequence of the finiteness of the energy range, it is always possible to set up an infinite set of holomorphic functions inside the error corridor, no matter how narrow it is, which are such that they differ by an arbitrary amount of any other point of the holomorphy domain. However, it is a remarkable mathematical fact that the maxima of the moduli of all these functions have to be greater than a certain lower bound which is uniquely determined and which can be computed numerically from the data function and its errors. This number can be used as a sensitive device for the location of the singularities as well as the zeros of the scattering amplitudes in a way which avoids the false particles that might be produced by specific parametrizations (e.g., Breit—Wigner form). The extreme sensitivity of this bias-free method to two model amplitudes, one of which exhibits a pole and the other a zero in the complex energy plane, is exemplified. (auth)

37344 UNITARIZATION OF THE VENEZIANO AMPLITUDE AND POMERON PROBLEM. Laperashvili, L. V. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 15: No. 3, 572-81 (Mar 1972). (In Russian).

Properties are investigated of the vacuum singularity for the nondual part of a scattering amplitude with nonidentical trajectories exchange which is constructed according to previous rules. Conditions were found for which $\alpha_{\rm vac}(0) = 1$. (auth)

37345 ENERGY POWER EXPANSION OF THE GREEN FUNCTION AND PADE APPROXIMATION FOR CUT-OFF POTENTIALS. Minelli, T. A. (Univ., Padua.); Zardi, F.; Vitturi, A. Lett. Nuovo Cim.; 4: No. 4, 105-9(27 May 1972).

A preliminary account is given of a new approach to the theory of scattering and bound states for cut-off potentials. This approach is based on the use of a modified Green function and on its analytic continuation in the complex energy plane. The essential feature of this approach is that the energy derivatives are obtained through an iterative method, which in the coordinate representation involves only repeated integrations of the Green function. The Pade approximation is used, which overcomes some of the difficulties of the Taylor expansion. Some preliminary results concerning the evaluation of cross sections are displayed; the agreement with the exact ones is very satisfactory. (L.B.S.)

37346 GENERAL PROPERTIES OF THE DUAL RESONANCE MODEL. Del Giudice, E.; Di Vecchia, P.; Fubini, S. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Ann. Phys. (N. Y.); 70: No. 2, 378-98(Apr 1972).

A general procedure is given for the construction of the physical states in the case of intercept $\alpha(0) = 1$. This procedure exhibits in an explicit form the "bootstrap" requirement that the spectrum of the intermediate states, obtained by the factorization of the scattering amplitude, is independent from the particular process used for constructing it. A big advantage of this way is that one avoids the unnecessary introduction of spurious states. The physical states are constructed together with their corresponding operators; this makes it then possible to get scattering amplitudes with the physical states on the external legs. Using the vertex operator associated with the photon-like particle of the level $\alpha(s) = 1$, an infinite number of orthogonal and positive norm states can be constructed growing up exponentially as the partition function of n objects with only two Lorentz components. The zero mass of the "photon" has been also used to construct operators which transform a physical state belonging to a certain multiplet $\alpha(s) = n$ into another physical state contained in the same multiplet. These operators should be intimately related to the degeneracy of the multiplets. An interesting by-product of this approach is the universality of the "electric charge" and the "magnetic moment." (auth)

37347 ADIABATIC DEFINITION OF THE S-MATRIX IN PRESENCE OF THE INFRARED DIVERGENCES. Tyupkin, Yu. S. (Moscow Engineering-Physics Inst.). Teor. Mat. Fiz.; 11: No. 2, 162-72(May 1972). (In Russian).

The adiabatic definition of the (renormalized) scattering matrix for the theories with infrared divergences is suggested, which is based on the adiabatic switching-on and switching-off the interaction. The equivalence of this definition to the usual one is established. (auth)

37348 ALGEBRAIC FACTORIZATION OF SCATTERING AMPLITUDES AT PHYSICAL LANDAU SINGULARITIES. Kershaw, David S. (Stanford Univ., Calif.). Phys. Rev., D; 5: No. 8, 1976-82(15 Apr 1972).

The behavior of the scattering amplitude in the vicinity of a physical Landau singularity is considered. It is shown that its singular part may be written as an algebraic product of the scattering amplitudes for each vertex of the corresponding Landau graph times a certain explicitly determined singularity factor which depends only on the type of singularity (triangle graph, square graph, etc.) and on the masses and spins of the internal particles. Thus the well-known result for single-particle-exchange poles is generalized to arbitrary physical Landau singularities. Also, it is shown that for any Landau singularity there exists a finite polynomial in the scalar products of the external four-momenta whose vanishing gives the Landau singularity curve. A general, purely algebraic, method is given for constructing this polynomial. (auth)

37349 RELATIVISTIC EIKONAL DYNAMICS. Cordero, P.; Fronsdal, C.; Gajdicar, T. (Univ. of California, Los Angeles). Phys. Rev., D; 5: No. 8, 2002-8(15 Apr 1972).

The eikonal formula for the scattering due to neutral-vector-meson exchange at very high energy in the generalized ladder approximation is obtained as the exact solution of a dynamical equation. This equation is obtained by applying high-energy approximations to an equation of the quasipotential type. The latter equation is known to have the correct low-energy limit and it therefore interpolates between high- and low-energy approximations to the generalized ladder approximation. (auth)

37350 Bi-REGGE-POLE DUALITY. Cohen, Larry K. (Univ. of Toronto). Phys. Rev., D; 5: No. 8, 2123-7(15 Apr 1972).

Following an earlier suggestion that local duality be applicable to high-energy wide-angle scattering, a duality equation for amplitudes is presented and discussed. Solutions are found in both equal- and unequal-mass cases. (auth)

37351 HIGH-ENERGY SCATTERING AT BACKWARD ANGLES. Reading, J. F.; Bassichis, W. H. (Texas A and M Univ., College Station). Phys. Rev., D; 5: No. 8, 2031-41(15 Apr 1972).

The previous attempt by Schiff to describe large-angle potential scattering is shown to be inaccurate for strong potentials. The reason for this is that a small ripple in partial-wave amplitude, t_l, of the order of $(ka)^{-1}(-1)^l t_l$ is neglected in the eikonal approximation. This ripple may produce a strong coherent effect in the backward direction. To overcome this difficulty the partial-wave sum for the second Born approximation is carried out exactly, and it is shown that a stationary phase, hitherto neglected, occurs in the oscillatory integrals. An application to the square-well potential shows that the error in the eikonal approximation is of order $(ka)^{-\frac{1}{2}}$ rather than $(ka)^{-1}$ as previously thought. Even more important is the fact that this occurs in the second Born term and that the cross section is now increased by a factor of $(V/E)^2(ka)$. Investigation of higher-order terms shows that one is, of,course, describing the square-well glory, but it is quite clear that these effects persist for potentials other than those with discontinuities. Finally, in a numerical check, a marked improvement in the fit to the correct differential cross section is observed when second- and third-order contributions are added to Schiff's essentially first-order result. (auth)

37352 COMPLEX POMERANCHUKON SINGULARITIES AND ASYMPTOTIC BEHAVIOR. Zaoui, Roger (Univ. of Maryland, College Park). Phys. Rev., D; 5: No. 8, 2084-7(15 Apr 1972).

It is assumed that the partial-wave amplitude of the scattering of two scalar bosons, in the t channel, has n complex-conjugate pairs of Pomeranchukon singularities of the form $\alpha(t) = 1 \pm \alpha\sqrt{t}$. The cases are considered where the complex singularities appear in an additive way and in a multiplicative way in the partial-wave amplitude. An asymptotic expansion is obtained for the scattering amplitude. Properties of the forward spike in the differential cross section, and the properties of the amplitude in connection with the Froissart bound and the violation of the Pomeranchuk theorem are discussed. (auth)

37353 COMPARISON OF APPROXIMATE METHODS FOR MULTIPLE SCATTERING IN HIGH-ENERGY COLLISIONS. Tobocman, W.; Pauli, M. (Case Western Reserve Univ., Cleveland). Phys. Rev., D; 5: No. 8, 2088-2101(15 Apr 1972).

The efficacy of several approximate methods for dealing with multiple-scattering processes is compared by applying these methods to a simple, soluble model. The model consists of the scattering of a particle by a pair of like particles with motion of all particles constrained to one dimension. Two cases are considered: (1) the target particles have a fixed separation and (2) the target particles are in a deuteron-like bound state with each other. The interaction of the incident particle with each target particle is the same and is chosen to be a zero-range potential. The potential binding the two target particles in case 2 is equal to this same zero-range interaction. The methods compared are the Born approximation for the T matrix, the impulse approximation for the T matrix, the WKB approximation, the Glauber approximation, second-order multiple-scattering theory for the T matrix, Born approximation for the K matrix, impulse approximation for the K matrix, and second-order multiple-scattering theory for the K matrix. For the fixed-separation case the K-matrix formalisms work much better than the T-matrix formalisms including Glauber theory. Second-order multiple-scattering theory is superior to Glauber theory for fixed separation. For case 2 the aforementioned approximate methods are used in conjunction with the adiabatic approximation. Comparison of the calculated transmission probabilities with the exact transmission probability shows the Glauber theory doing much better than any of the other approximate methods. The success of the Glauber theory results from its suppression of a second-order term in the multiple-scattering expansion which is inadequately damped by the adiabatic approximation. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 36806.

37354 REDUCED DENSITY-MATRIX EQUATIONS AND SUPERFLUID HYDRODYNAMICS. Haug, H.; Weiss, K. (Philips Research Labs., Eindhoven, Netherlands). Physica; 59: No. 1, 29-46(1 May 1972).

A theory is developed that shows explicitly how Bose condensation leads to the phenomenological theory of superfluidity. Starting with the concept of off-diagonal long-range order for the reduced one-particle density matrix for an interacting Bose system, a closed set of hydrodynamic equations for the condensate and the depletion is derived. Viscous terms are not included. This set of equations is used to construct the hydrodynamic conservation laws. From a systematic comparison with Landau's phenomenological theory simple analytic connections between the densities and the velocities of the microscopic and the phenomenological theories are obtained. The validity of these relations is limited to low densities and to temperatures near T_{λ}. An explicit expression for the transition rate between the super and the normal component is given, and all thermodynamical functions are calculated. From the equation of motion for the condensate wave function, an equation for the thermodynamical order parameter is derived that is valid in the vicinity of T_{λ}. (auth)

37355 SINGULARITIES OF THE DIAGRAM OF STATE OF AN ^{3}He–^{4}He MIXTURE DUE TO THE HYDROSTATIC EFFECT. Berestov, A. T.; Voronel, A. V.; Giterman, M. Sh. (All-Union Research Inst. for Physical Technical and Radio Measurements, Moscow). JETP Lett. (USSR) (Engl. Transl.); 15: No. 5, 190-3 (5 Mar 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 5, 273-6(5 Mar 1972).

The diagram of state of the ^{3}He–^{4}He mixture has a region of separation into two liquid phases, the phase with the lower ^{3}He concentration remaining superfluid. The coexistence curve of the liquid phases, when plotted in coordinates T and X, has according to the latest experiments a unique form, which has induced a number of workers to construct specific theories of this phenomenon. It is shown that the form of the coexistence curve of this mixture, under the conditions of the experiment [Graf, et al., Phys. Rev. Lett. 19, 417(1967)], is determined by the hydrostatic effect, i.e., by the concentration inhomogeneity due to the gravitation field, and remains therefore a function of the experimental conditions. This explains the discrepancies between the data of different authors. (M.H.R.)

37356 JOSEPHSON-LIKE PHASE-COHERENCE OSCILLATIONS IN SUPERFLUID HELIUM. Perrin, B.; D'Humieres, D.; Laroche, C.; Hulin, J. P.; Libchaber, A. (Ecole Normale Superieure, Paris). Phys. Rev. Lett.; 28: No. 24, 1551-3(12 Jun 1972).

A study is reported of the oscillations of two superfluid helium baths coupled through a small hole. At low temperature they are associated with gravitational potential energy and kinetic energy through the hole. At high temperature, an entropy term must be added and the oscillations are dispersive. From an amplitude study it is shown that two critical velocities appear, depending on the presence or absence of a superleak. This experiment is an analog of Josephson plasma oscillations in that the phase of the wave function oscillates with time. (auth)

37357 EQUILIBRIUM THEORY OF THE DILUTE SOLUTIONS OF ^{3}He IN SUPERFLUID ^{4}He AT VERY LOW TEMPERATURES. Disatnik, Y.; Brucker, H. (Tel-Aviv Univ., Israel). J. Low Temp. Phys.; 7: No. 5-6, 491-523(Jun 1972).

An equilibrium theory of the dilute solutions of ^{3}He in superfluid ^{4}He is derived systematically. The theory is based on a model which (a) goes beyond the parabolic Landau–Pomeranchuk approximation for the ^{3}He quasi-particle energy by taking into account the fourth-order term in the momentum expansion of this quantity, (b) disregards contributions to the ^{3}He quasi-particle effective interaction whose order in the momentum is higher than two, and (c) allows the effective interaction to be nonlocal. The simplicity of the model enables the development of a unified parametrization of the various equilibrium properties of the solutions. The expressions obtained for these properties are both easy to apply and highly accurate over a wide temperature range from T = 0 to temperatures of the order of the ^{3}He quasi-particle degeneracy temperature. It is shown that the parameters appearing in the expression for the ^{3}He quasi-particle effective interaction at fixed ^{4}He number density are replaced in the fixed-pressure, low-temperature expansions of the equilibrium properties by other parameters whose appearance in the theory seems to be due to the renormalization of this interaction by the interactions between the ^{3}He quasi particles and the virtual fluctuations of the ^{4}He number density. Finally, a comparison is made between theory and experiment. Three quantities are considered in detail: the ^{3}He osmotic pressure and the ^{3}He quasi-particle inertial and specific heat effective masses. The analysis of the experimental data makes it possible to determine the parameters associated with the effective interaction at several pressures. It is found that the theory is, in general, in very good accord with the experimental situation and that, within its framework, the experimental values of the osmotic pressure and the two effective masses are indeed consistent with one another. (auth)

37358 PHONON–PHONON INTERACTIONS AND PROPAGATION OF SOUND IN LIQUID ^{4}He. Meier, P. F.; Beck, H. (Univ., Zurich). J. Low Temp. Phys.; 7: No. 5-6, 381-98(Jun 1972).

The quantum-hydrodynamical model for excitations in He II at low temperatures is used to calculate the velocity shift and the attenuation of ultrasound in the collisionless domain. First, starting from a linear spectrum, the self-energy needed for the evaluation of the density–density correlation function is derived in lowest order of perturbation theory. Particular attention is then paid to a self-consistent determination of the real part of the pole of the retarded Green's function. This procedure turns out to be essential for this model. Second, the influence of a nonlinear spectrum and of a finite lifetime of thermal phonons is investigated. (auth)

Superconductivity

Refer also to abstract 36603.

37359 LOWER CRITICAL FIELD MEASUREMENTS IN NbN BULK AND THIN FILMS. Mathur, M. P.; Deis, D. W.; Gavaler, J. R. (Westinghouse Research Labs., Pittsburgh). J. Appl. Phys.; 43: No. 7, 3158-61(Jul 1972).

Low-field magnetization measurements were made at 4.2°K on thin-film and bulk NbN samples using a vibrating-sample Foner magnetometer. These data can be used to calculate the upper critical field, H_{c2}, without having to resort to resistivity data, which, particularly in the case of NbN, yield very anomalous results. In the present work the experimental value of H_{c1} is obtained from the magnetization curves and H_{c2} is then calculated using the GLAG equations. These calculations and the significance of the Pauli spin paramagnetism and spin–orbit scattering in these materials are discussed. (auth)

37360 HIGH-FREQUENCY RESPONSE OF JOSEPHSON POINT CONTACTS. Kanter, H.; Vernon, F. L. Jr. (Aerospace Corp., El Segundo, Calif.). J. Appl. Phys.; 43: No. 7, 3174-83 (Jul 1972).

For a current-driven Josephson junction shunted by an Ohmic resistance, the dc voltage response and impedance to external high-frequency currents is calculated with a second-order perturbation method based on the unperturbed solution for the time evolution of the voltage as given by Aslamazov and Larkin. The response is proportional to signal power and has three characteristic-frequency regions depending on whether the internal self-generated Josephson frequency, ω_0, is larger than, equal to, or smaller than the signal frequency, ω. For $\omega_0 <$ or $> \omega$ the response could be expressed by easily observable parameters of the dc voltage-current characteristics. This permits comparison of the predictions with experimental results obtained on point-contact junctions whose dc characteristics were only approximately represented by the simple model chosen for analysis. For $\omega_0 \ll \omega$ the response is found to be proportional to (i) the slope of the dc characteristic, (ii) the inverse square of the applied frequency, (iii) the inverse battery current in terms of the critical current, and (iv) the voltage amplitude of the inherent Josephson oscillations. For $\omega_0 \gg \omega$ classical detection proportional to curvature is obtained. For $\omega_0 \sim \omega$ resonance detection occurs, which depends to a considerable degree on fluctuations of the average contact voltage. These predictions are in reasonable agreement with experiments in which point-contact junctions were illuminated with klystron radiation at 10 and 90 GHz. Evidence is presented that the voltage fluctuations limiting the resonance response are the result of noise generated in the junction. Comparison of the noise-equivalent power expected from the simple model with measured results suggests that parasitic elements, such as shunt capacity, are not negligible at 90 GHz. (auth)

37361 FLUX LINE PINNING BY LARGE NORMAL PARTICLES IN TYPE-II SUPERCONDUCTORS. Coote, R. I.; Evetts, J. E.; Campbell, A. M. (Cambridge Univ., Eng.). Can. J. Phys.; 50: No. 5, 421-7(1 Mar 1972).

The pinning of flux lines by large normal particles was investigated as a function of field and temperature. The results are compared with a model for the magnetic pinning interaction at a phase boundary. The problem of the summation procedure for individual pinning interactions is discussed, and it is concluded that the distortion of the flux line lattice caused by large normal particles is large enough for a simple direct summation to apply. This conclusion is supported by the experimental results. The experimental results also indicate that Anderson flux creep is not significant in this type of pinning system. (auth)

37362 NUCLEAR SPIN–LATTICE RELAXATION IN SUPERCONDUCTING Al. Carbotte, J. P.; Truant, P. T. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 6, 563-6(15 Mar 1972).

The temperature variation of the nuclear spin–lattice relaxation rate in superconducting aluminum was calculated taking account of the anisotropy in the energy gap that Leavens and Carbotte have recently calculated from microscopic theory. This variation was compared with the available experimental data for the region near the critical temperature. (auth)

37363 CAUSE OF SUPERCONDUCTIVITY. III. Krebs, H. (Univ., Stuttgart). Z. Naturforsch.; 27a: No. 2, 236-49(Feb 1972). (In German).

By consideration of superconducting compounds whose chemical bond nature is known or can be derived with some certainty, it is shown that superconductivity only occurs if valency electrons of a band can move in at least one space direction without intersecting any nodal surfaces. This applies both for metallic substances and for semiconductors. The following examples are discussed: (1) metallic and semiconducting compounds composed of elements of the main groups and having a lattice similar to that of NaCl; (2) Nb- and Ta-chalcogenides with MoS_2-structure; (3) the clathrate-compound $[Ag_7O_8]^+X^-$; (4) LaC_2 with CaC_2-structure; (5) metallic and semiconducting perovskites; (6) spinels and interstitial compounds with NaCl-structure; (7) pyrites; and (8) some metals and their alloys. In the case of s electrons, this condition is fulfilled for all space directions; in the case of δ bonds only along the intersecting line of the two nodal planes. A "δ" bond is often—especially in an NaCl-type lattice—associated with a translation perpendicular to this intersecting line (in the NaCl-type lattice a translation by a/2) and a rotation by 90°. In such a "δ_t"-bond system, the four segments of a d_{t2g} electron belong to four adjacent channels of quadratic cross section (in the NaCl-type lattice the side length is a/2) which are not intersected by nodal surfaces. Only electrons fulfilling the condition indicated above can be considered as free electrons. (auth)

37364 IMPROVEMENTS IN OR RELATING TO SUPERCONDUCTORS. (to Maschinenfabrik Oerlikon). British Patent 1,273,924. 10 May 1972. Priority date 21 Jan 1970, Switzerland.

A process is given for the production of a stabilized superconductor having a plurality of superconducting filaments. A tube of normally conducting material (Cu) is filled with small Cu tubes, whose interior is filled loosely with fitting rods of superconducting material (Nb–Ti). The assembly is subjected to hot or cold working to form a metallic bond between the normal and superconducting materials, without forming an eutectic or intermetallic compound. The small tubes may have a hexagonal periphery and a circular inner cross section. The diameters and the reduction are selected such that the superconducting filaments have a diameter of 5 to 50μ. (D.L.C.)

37365 SUPERCONDUCTING ALLOYS OF VANADIUM WITH TITANIUM ALLOYED WITH HAFNIUM AND RHENIUM. Baron, V. V.; Efimov, Yu. V. pp 161-5 of Probl. Sverkhprovodyashch. Materialov. Moscow; Izdatel'stvo Nauka (1970). (In Russian).

The effects of separate additions of Hf and Re up to 10 at. % on the superconducting and mechanical properties of an equiatomic V–Ti alloy were studied; the Hf and Re were added at the expense of the Ti. These additions increase the hardness and strength of the alloys but lower the superconducting properties. With Hf ≤ 1.0 at. % or Re ≤ 5 at. % the cold-working properties were improved. These alloys have adequately high superconducting properties, e.g., T_c is 7 to 8°K, and the critical current density is 1.5×10^4 A/cm^2 at 4.2°K and 26 kOe. (Referativnyi Zh.)

37366 METALLURGICAL ENHANCEMENT OF TYPE II SUPERCONDUCTORS. Dew-Hughes, D. (Univ. of Lancaster, Eng.). Rep. Progr. Phys.; 34: No. 9, 821-73(1971).

The application of superconductivity to electrical engineering requires the availability of type-II superconductors with high critical temperatures, high upper critical fields, high critical current densities, high stability, and low ac losses. These properties are related to the composition, metallurgical treatment, and structure of superconducting materials. In this review, the best results achieved to date are related to the current theories and, insofar as is possible, predictions are given as to the likely upper limits of these quantities. Methods by which improved materials may be made are indicated, and finally the situation with regard to currently available commercial materials is briefly summarized. (auth)

37367 NEW TECHNIQUE TO MEASURE AC LOSSES IN SUPERCONDUCTORS BY THE BOIL-OFF METHOD. Furtado, C. S. (Clarendon Lab., Oxford). Cryogenics; 12: No. 3, 230-1(Jun 1972).

The apparatus includes a needle valve from the settings of which the values of the ac losses are determined. Results obtained agreed well with those obtained by electrical methods. The technique has a sensitivity of about 10μW. Advantages compared with earlier "boil-off" methods are stated. (UK)

37368 SUPERCONDUCTING PROPERTIES OF Nb: 25 PERCENT Zr RELEVANT TO ITS USE IN A SUPERCONDUCTING POWER CABLE. Milne, I.; Ward, D. A. (Central Electricity Research Labs., Leatherhead, Eng.). Cryogenics; 12: No. 3, 176-9(Jun 1972).

The critical current density of co-processed copper-clad Nb–25%Zr wire was studied as a function of annealing time and temperature with reference to its use in a superconducting power transmission cable. By a suitable choice of annealing conditions, a critical current density of more than 9 kA mm^{-2} was obtained at 6.5°K in a 250 μm wire in zero applied field. This exceeds the minimum likely to be necessary for the hard type-II component in a cable. It is suggested that the sharply defined dislocation substructure is more likely to control the critical current density in the specimens investigated than either the β_{Zr} or α_{Zr} precipitates. (auth)

37369 THEORY OF A SURFACE MIXED STATE IN SUPERCONDUCTORS OF THE FIRST KIND. Andreev, A. F.; Tekel, P. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1540-7(Apr 1972). (In Russian).

The structure of a "superconducting" layer covering the inner surface of a hollow cylindrical current-carrying superconductor is elucidated. The electromagnetic impedance of the inner surface is calculated. Behavior of the system in a transverse external magnetic field is investigated. (auth)

37370 AMPLITUDE-DEPENDENT SHEAR WAVE ATTENUATION NEAR T_c IN RHENIUM. Robinson, D. A.; Levy, M. (Univ. of Wisconsin, Milwaukee. Univ. of California, Los Angeles). Appl. Phys. Lett.; 20: No. 10, 381-2(15 May 1972).

A novel approach using a mixed-mode transducer for measuring shear-wave attenuation near T_c in rhenium was used to show that the shape of the attenuation curve depends on the ultrasonic wave amplitude. (auth)

37371 SUPERCONDUCTING PROPERTIES OF MULTIFILAMENTARY Nb_3Sn MADE BY A NEW PROCESS. Suenaga, M.; Sampson, W. B. (Brookhaven National Lab., Upton, N. Y.). Appl. Phys. Lett.; 20: No. 11, 443-5(1 Jun 1972).

A new processing method for producing multifilamentary A-15 superconducting composite wires in a ductile matrix is described. Nb_3Sn made in this way was found to have a critical temperature of 17.5°K and a critical current density of 7.5×10^5 A/cm^2 at 40 kG when suitably heat treated. The composite conductor could be bent with a radius of 2 cm or greater without appreciable degradation of its current-carrying capacity. (auth)

37372 PHASE TRANSITION OF FIRST ORDER IN SUPERCONDUCTORS AT H_{c1}. Grossmann, S.; Wissel, Ch. (Philipps Univ., Marburg, Ger.). Z. Phys.; 252: No. 1, 74-83(1972).

The Ginzburg–Landau functional is extended by nonlinear terms. The corresponding Ginzburg–Landau equations are solved by a method analogous to Abrikosov's theory near H_{c2}. But it yields the magnetization as a function of H_{ex} in the whole vortex phase, presuming that κ is near $1/\sqrt{2}$. At H_{c1}, a jump in the magnetization is found. (auth)

37373 SUPERCONDUCTIVITY OF SEMICONDUCTING CRYSTALS IN THE RADIATION FIELD OF A LASER. Blazhin, V. D.; Selivanenko, A. S. (Lebedev Physics Inst., Moscow). Sov. Phys.-Semicond. (Eng. Transl.); 5: No. 9, 1480-2(Mar 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 9, 1691-4(Sep 1971).

A theoretical analysis is made of the interaction of the conduction electrons in a crystal with the optically induced polarization of the valence electrons. It is shown that such an interaction may give rise to a fairly strong electron—electron attraction, i.e., it may lead to high-temperature superconductivity. (auth)

37374 IMPROVEMENTS IN SUPERCONDUCTOR STRIPS. (to Compagnie Francaise Thomson Houston-Hotchkiss Brandt). British Patent 1,275,476. 24 May 1972. Priority date 12 Sep 1968, France.

The superconductor strip described consists of a support having elongated superconducting elements distributed thereon. The strip is coated with a binder with electrically insulating properties. (M.H.R.)

37375 CONDUCTOR COMPRISING SUPERCONDUCTIVE MATERIAL. Ziemek, Gerhard; Scheffler, Ernst (to Kabel- und Metallwerke Gutehoffnungshuette Aktiengesellschaft). British Patent 1,275,985. 1 Jun 1972. Priority date 30 Nov 1968, Germany.

The conductor described consists of a layer of superconductive material mounted on a carrier, suitable for use in cables operated at very low temperatures with one or more conductors, in which the layer comprises a strip formed longitudinally into a tube. The edges of the tube are welded together, mounted on one or more carrier bodies. The thickness of the strip is from 0.03 to 0.5 mm. (M.H.R.)

37376 LOCAL MODEL OF NONIDEAL TYPE-II SUPERCONDUCTORS. II. FLOW CONDUCTIVITY. Matsunaga, Sakuro (Japan Atomic Energy Research Inst., Tokai). Jap. J. Appl. Phys.; 11: No. 6, 893-903(Jun 1972).

The flow conductivity of nonideal type-II superconductors with pinning force is presented using the local model, in which the local field of fluxoid is given by modifying the general solution of the London equation. The local field is deformed due to the motion of fluxoid. The amplitude of the deformation in ideal superconductors without pinning force is derived by comparing the flow conductivity calculated by the local model with that by the time-dependent Ginzburg—Landau theory. The flow conductivity of nonideal superconductors is calculated by superposing the deformation due to the motion of fluxoid on that due to the pinning force. As the result of the superposition of both the deformations, the flow conductivity of nonideal superconductors becomes smaller than that of ideal superconductors. Further, varieties of J_t—V characteristics in the nonideal superconductors are explained by the growth of the deformation. (auth)

37377 INDUCED SUPERCONDUCTIVITY IN SILVER: ENERGY GAP AND ELECTRON—ELECTRON INTERACTION. Wolf, S. (Case Western Reserve Univ., Cleveland); Hsieh, S. Y.; Deutscher, G.; Lindenfeld, P. Solid State Commun.; 10: No. 9, 909-13(1 May 1972).

Thermal conductivity measurements on double and triple layers of thin films of silver and a lead—bismuth alloy were used to determine the energy gap in the silver. In double layers and dirty triple layers the gap was the same as that observed in tunneling measurements. In clean triple layers a smaller gap was observed as a result of the low energy excitations travelling parallel to the interface. An analysis leads to the conclusion that the electron—electron interaction in silver is attractive, with $(NV)_{Ag} = 0.1$. (auth)

37378 INFLUENCE OF Al_2O_3 ADDITIONS ON THE SUPERCONDUCTING BEHAVIOUR OF NIOBIUM. Best, K.-J.; Pfeiffer, I. (Vacuumschmelze GmbH, Hanau, Ger.). Solid State Commun.; 10: No. 9, 901-3(1 May 1972).

Cold worked wires of sintered Nb with Al_2O_3 additions (maximum addition 2 wt. %) showed considerably increased values of H_{c2} and residual resistance with increasing Al_2O_3 additions. This effect can be explained by the presence of soluted Al produced by Al_2O_3 reduction during the sinter process and by the interactions of the Al atoms with dislocation structures due to heavy cold work. (auth)

37379 SUPERCONDUCTOR STRUCTURE, AND METHOD OF MAKING THE SAME. (to Compagnie Francaise Thomson Houston-Hotchkiss Brandt). British Patent 1,275,439. 24 May 1972. Priority date 18 Oct 1968, France.

A superconducting structure adapted to be cooled by a cryogenic fluid is described. It is composed of a fluid-tight metallic tube adapted to contain the cryogenic fluid, a filamentary superconductor located in the tube, and a metallic sheath surrounding the superconductor. The sheath is secured with a substantially line contact to the inside wall of the tube and with a smaller outside diameter than the inside diameter of the tube. (M.H.R.)

37380 ANALOGY BETWEEN SUPERCONDUCTORS AND SMECTICS A. de Gennes, P. G. (Laboratoire de Physiques des Solides, Orsay, France). Solid-State Commun.; 10: No. 9, 753-6(1 May 1972).

The conformation of a smectic A (layered system) can be described by a phase function $\phi(R)$, the n-th layer corresponding to $\phi(R) = 2\pi n$. The role of the phase in smectics A and in superfluids is similar. This analogy leads to the following predictions for a second order smectic A $\leftrightarrow$ nematic transition: (1) the transition temperature is lowered if twist or bend distortions are imposed; these distortions correspond to a magnetic field in superconductors; (2) the Frank coefficients K_2 and K_3 of the nematic phase must show pretransitional anomalies. (auth)

37381 SELF-CONSISTENT PAIR POTENTIAL IN AN INHOMOGENEOUS SUPERCONDUCTOR. Bar-Sagi, J.; Kuper, C. G. (Technion-Israel Inst. of Tech., Haifa). Phys. Rev. Lett.; 28: No. 24, 1556-9(12 Jun 1972).

de Gennes's equations for the Bogolyubov amplitudes in an inhomogeneous superconductor are solved in a simple geometry with the use of a one-parameter Ansatz for the pair potential. The solutions are used to determine the parameter self-consistently. In the limit $T \rightarrow T_c$, the results agree with the Ginzburg—Landau theory, but the present method is applicable at all temperatures $T < T_c$. (auth)

37382 SUPERCONDUCTING STATE UNDER THE INFLUENCE OF EXTERNAL DYNAMIC PAIR BREAKING. Owen, C. S.; Scalapino, D. J. (Univ. of California, Santa Barbara). Phys. Rev. Lett.; 28: No. 24, 1559-61(12 Jun 1972).

A model is developed for a superconductor under an external dynamic pair-breaking influence such as a flux of optical photons. The recombination time for quasi particles to form pairs is much greater than the characteristic time for their thermalization to the lattice temperature T. For this reason the model treats the unpaired electrons as a Fermi gas at temperature T, but more numerous than in the complete equilibrium situation. (auth)

37383 INELASTIC NEUTRON SCATTERING FROM THE VORTEX LATTICE IN TYPE-II SUPERCONDUCTORS. I. Maki, Kazumi (Kernforschungsanlage, Julich, Ger.). J. Low Temp. Phys.; 7: No. 5-6, 369-80(Jun 1972).

The inelastic neutron scattering from the vortex lattice in dirty type-II superconductors is considered. In the high-field region, the correlation function for the local magnetization is given in terms of the fluctuation propagator of the superconducting order parameter. In particular it is shown that the Fourier transform of the correlation function for the local magnetization diverges as $|q_\perp - G_i|^{-2}$, when the transverse transferred momentum $q_\perp$ approaches the reciprocal lattice vector G_i of the Abrikosov lattice. This term gives rise to tails around each Bragg peak in the inelastic neutron-scattering cross section. (auth)

37384 ELECTRON—PHONON INTERACTION IN ALUMINUM FROM ULTRASONIC ATTENUATION MEASUREMENTS. Berre, B.; Vetleseter, A. (Univ. of Oslo). J. Low Temp. Phys.; 7: No. 5-6, 399-414(Jun 1972).

The attenuation of longitudinal sound waves in normal and superconducting aluminum was measured, yielding the electronic contribution to the normal-state attenuation. The electron—phonon interaction constant is found to be in good agreement with the calculated constant based on Pippard's theory. The experiments support the assumption of an isotropic deformation parameter K_x, using Segall's and Ashcroft's modifications of the Harrison model of the Fermi surface. (auth)

37385 MAXIMUM CURRENT OF A SUPERCONDUCTING WIRE IN A TRANSVERSE MAGNETIC FIELD IN THE CASE OF WEAK PINNING. Grensing, Dieter (Univ., Kiel). J. Low Temp. Phys.; 7: No. 5-6, 433-48(Jun 1972).

A model of weakly pinned flux lines is described, permitting the calculation of the maximum-current transverse-field characteristic of a superconducting wire in the range of low fields. Studying the penetration of the first flux lines, the initial shape of the maximum current curve is found to be linear, up to a field which depends on the strength of pinning. Beyond this field the calculation of the maximum current requires a determination and investigation of the field distribution inside and outside the wire. This leads, the vortex state being only partially achieved, to a Hilbert problem involving a free boundary. (auth)

37386 SPECIFIC HEAT OF TYPE-II SUPERCONDUCTORS IN MAGNETIC FIELDS NEAR T_c. Ehrat, R.; Rinderer, L.

(Univ., Lausanne, Switzerland). J. Low Temp. Phys.; 7: No. 5-6, 533-71(Jun 1972).

The GLAG theory predicts that the value of the specific heat C_M in the mixed state, just below the transition to the normal state, is a function of the Ginzburg–Landau (GL) parameter κ, even for vanishingly small magnetic fields ($T \approx T_c$). C_M is thus different from the specific heat C_S in the pure superconducting state ($H = 0$) for all κ except $\kappa \cong 1.9$. Experimental results of the authors generally confirm this paradoxical prediction which is not in contradiction with the thermodynamics of phase transitions. To experimentally clarify this behavior close to T_c, $Nb_{80}Mo_{20}$ ($\kappa \cong 4$) and $Pb_{98}In_2$ ($\kappa \cong 0.8$) specimens are studied in fields much smaller than those usually applied (down to 17 Oe). A new method for measuring specific heat in decreasing as well as increasing temperature is introduced. Very good agreement with the theory is found for fields higher than ~120 Oe, while a deviation is observed close to T_c for lower fields where values of the Abrikosov lattice parameter would become larger than 1 μ. The sense and the magnitude of the deviation are such that C_M and C_S would be equal for fields of 20 Oe and below. Possible explanations are discussed. It is suggested that a fundamental modification of the vortex state structure occurs in small fields close to T_c. (auth)

37387 SUPERCONDUCTING AND MAGNETIC PROPERTIES OF $La_{3-x}InCe_x$. Jones, H.; Fischer, Oe.; Bongi, G.; Treyvaud, A. (Univ., Geneva). Solid State Commun.; 10: No. 10, 927-31(15 May 1972).

Measurements of the critical temperature, $T_c(x)$, the critical field, $H_{c2}(x,T)$ and the susceptibility, $\chi(T)$, as a function of the concentration, x, in the system $La_{3-x}Ce_xIn$, are compared with the theories of Muller–Hartmann and Zittartz, and Abrikosov and Gor'kov. The $H_{c2}(x,T = 0)$ and $\chi(T)$ measurements indicate the appearance of short range antiferromagnetic order around $x = 0.04$ which is probably responsible for the anomalous behavior of $T_c(x)$. (auth)

37388 INFLUENCE OF CORRELATED SPINS ON THE SUPERCONDUCTING TRANSITION TEMPERATURE. Rainer, Dierk (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 252: No. 2, 174-88(1972).

Using a variational procedure, the depression of the superconducting transition temperature by a system of correlated moving spins is calculated. In particular, corrections to the Abrikosov–Gorkov theory in the neighborhood of a magnetic phase transition are examined. Characteristic differences in the concentration dependence of the superconducting transition temperature are found in the cases of ferromagnetic and antiferromagnetic spin correlations. (auth)

Equipment and Devices

Refer also to abstracts 36300, 36651, 36653, 36654, and 36687.

37389 (NP–19323) FIELD ERRORS DUE TO WINDING TOLERANCES IN A SUPERCONDUCTING BENDING MAGNET. Ries, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec 1971. 11p. Dep. NTIS (U. S. Sales Only).

A superconducting bending magnet with a winding cross section composed of a number of rectangular winding blocks is considered. The influence of deviations in positions and dimensions on the field quality in the aperture is expressed to first order in a multipole expansion for the field disturbances. A suitable statistical average over all blocks is proposed and admissible mechanical tolerances for a synchrotron bending magnet with respect to slow resonant extraction are evaluated. (auth)

37390 CRYOSTAT. (to Compagnie Generale d'Electricite). British Patent 1,273,868. 10 May 1972. Priority date 30 Sep 1969, France.

A cryostat is designed with a superconductive load circuit. This circuit is supplied with electric current by means of two leads, each with a superconductive part partially immersed in a cryogenic liquid and in thermal contact with a tubular member. One end of the tubular member contacts the cryogenic liquid, and means are provided for adjusting the liquid level within the tubular members. The superconductive load circuit includes a superconductive coil in parallel with a superconductive switch. Heat losses are small. (D.L.C.)

37391 IMPROVEMENTS IN OR RELATING TO CONDUCTORS FOR SUPERCONDUCTING POWER TRANSMISSION CABLES. Taylor, Malcolm Thomas; Graeme-Barber, Christopher (to Central Electricity Generating Board). British Patent 1,272,656. 3 May 1972. Filed 13 Oct 1969.

In fabrication of tubular conductors for superconducting power transmission cables described here, composite strip having layers of superconducting and nonsuperconducting materials of the required thickness is formed and a tube then fabricated from the strip by butt welding. The edges of the strip to be welded have a continuous coating of a material that is superconducting at the desired operating temperature. The welds may be longitudinal or helical, and the composite strip may be made up of strips of Nb-coated Al or Cu, with Nb as the superconducting material (or Nb–Zr or Nb–Ti alloy). The cable may also be of coaxial construction. (UK)

37392 200 mW RECIRCULATING ^{3}He REFRIGERATOR. Wilkes, W. R. (Mound Lab., Miamisburg, Ohio). Cryogenics; 12: No. 3, 180-3(Jun 1972).

A recirculating ^{3}He refrigerator is described in which the compressed ^{3}He is cooled below 4.2 K by means of a heat exchanger rather than a pumped ^{4}He bath. This design eliminates the requirement for large capacity pumps and a separate pumped ^{4}He bath. In continuous operation, a refrigeration power of 200 mW is available at 1.85 K, using a 150 1 min^{-1} mechanical pump and an inexpensive compressor. (auth)

PHYSICS (NUCLEAR)

37393 (ANU-P-542) ANNUAL REPORT, 1971. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Jan 1972. 41p. Dep. NTIS (U. S. Sales Only).

The research equipment and program are described. A tandem accelerator currently in use is to be complemented by injection from a cyclotron. The program is divided into reaction mechanism studies, nuclear astrophysics, isobaric analog studies, heavy ion induced reactions, radiative proton capture studies using Ge(Li) detection, radiative capture of complex particles using Na(Tl) detection, general nuclear spectroscopy and beam foil spectroscopy. Staff publications for the year are listed. (Australia)

Neutron Interactions with Matter

Refer also to abstracts 36152, 36297, 37737, 37798, and 37999.

37394 (AAEC/TM-617) MEASUREMENT OF THERMAL NEUTRON WAVES AT HIGH FREQUENCIES IN BeO. Ritchie, A. I. M.; Whittlestone, S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1972. 28p. Dep. NTIS (U. S. Sales Only).

The amplitudes and phases of neutron waves have been measured in a BeO assembly in the frequency range 515.7 Hz to 1719 Hz. The results confirm earlier measurements that below $\sim$520 Hz the neutron wave has the properties of a discrete mode of propagation. At frequencies $\geqq$720 Hz the attenuation $\alpha(z)$ and phase shift parameters $\xi(z)$ change with distance from the source, the change being more marked the higher the frequency. The observed spatial variations of $\alpha(z)$ and $\xi(z)$ do not agree with present theoretical predictions. Interference effects predicted by theory have not been observed. (auth)

37395 (ANL-7406) TESS: A ONE-DIMENSIONAL S_n TRANSPORT-THEORY CODE FOR THE CDC-3600. Goin, Ronald W.; Plummer, J. P. (Argonne National Lab., Ill.). Dec 1971. Contract W-31-109-eng-38. 152p. Dep. NTIS.

TESS is a code, written in FORTRAN, which provides the multigroup real and adjoint solutions to the transport equation in the S_n approximation for one-dimensional slab and spherical geometry. A direct method of solution for each outer iteration is used for maximum efficiency in slowly converging problems. A double S_n formulation in slab geometry, which allows the code to treat discontinuities more efficiently in the angular flux at interfaces, yields more accurate results with fewer angles. TESS contains a sophisticated cross-section homogenization routine, which permits cross-section collapse in both space and energy by six different prescriptions—three by real flux weighting, and three by flux and adjoint weighting. In addition, two different methods of providing for cell leakage make the code convenient for fast-reactor, critical-facility heterogeneity studies. Highly generalized boundary-condition capabilities make TESS quite suitable for photon-transport problems as well. Integrals of flux and adjoint for perturbation analysis can be calculated. Reaction rates may be computed for specified isotopes as a function of space. (auth)

37396 ATTENUATION OF FAST NEUTRONS IN SHIELDING MATERIALS. Gujrathi, S. C.; D'Auria, J. M. (Simon Fraser Univ., Burnaby, British Columbia). Nucl. Instrum. Methods; 100: No. 3, 445-52(1972).

The attenuation of a fast ($\approx$2.6-MeV) neutron beam by various new, polymeric materials was measured using an indirect method with a Ge(Li) gamma-ray spectrometer. In addition, an attempt was made to estimate the effect of these materials on the thermal flux. Macroscopic removal cross sections for the elements involved were deduced and compared with values inferred from total microscopic cross sections. (6 figures, 2 tables) (auth)

37397 VARIATIONAL METHODS APPLIED TO NEUTRON TRANSPORT THEORY IN INHOMOGENEOUS MEDIA. Holley, Heinz-Peter. University Park, Pa.; Pennsylvania State Univ. (1971). 56p. University Microfilms Order No. 72-13,871.

Thesis.

Systematic variational procedures are developed for approximate solution of plane symmetry, monoenergetic transport problems with isotropic secondary neutron emission in inhomogeneous media. Inhomogeneity due to variable mean free paths is trivially eliminated by the familiar introduction of the optical location variable, x. The important inhomogeneity treated is variation with location of the number of secondary neutrons emitted in a neutron-nucleus collision, c(x). The two classes of inhomogeneity which are discussed are the case of a step change in c (i.e., the adjacent half-space problem, or single half-space problem), and the case of a continuously varying c in the region between two, separated, homogeneous half-spaces. The test problem applied to each technique and each case is a generalized Milne problem (i.e., with a neutron source located far from inhomogeneities in one of the half-spaces). Three variational techniques are developed and applied to the test problem. Specifically, the method of overlapping spectra, the use of discontinuous trial functions, and the "mixing" of solutions are investigated. The angular trial functions employed in each technique are given by the exact asymptotic forms found in the homogeneous half-spaces, viz., the discrete indexed normal modes for the homogeneous half-spaces of the particular problem considered. For the cases involving a step change in c, results of calculations using the three techniques are compared to exact solutions, the parametric fitted results of Kaplan, and to results based on a P_1-approximation which are of about the same calculational difficulty as the present methods. Good agreement with exact solutions is obtained in all cases. The accuracy realized in considering this class of problem lends support to the application of similar techniques for the case of continuously variable c. Systematic procedures are developed for determining trial functions for the case of a continuously variable c for a slab embedded between two constant c half-spaces. For a specific form of c(x), detailed iterative solution techniques are applied to the test problem and the results are compared to those of a Monte Carlo numerical experiment. Impressive accuracy of the variational technique is also found for this case. The variational procedures developed offer a systematic method for the solution of monoenergetic neutron, or neutral particle, transport problems with isotropic secondary emission in inhomogeneous media. (Diss. Abstr. Int., B)

37398 GREEN'S FUNCTION TECHNIQUE FOR NEUTRON THERMALIZATION IN A PROTON GAS. Wu, Shao-pu. Raleigh, N. C.; North Carolina State Univ. (1971). 346p. University Microfilms Order No. 72-15,906.

Thesis.

This research deals with the development of the Green's function technique for neutron thermalization in an infinite, homogeneous medium consisting of atomic hydrogen. The mathematical analysis is based on the so-called proton gas model. Effects of resonance absorption and the spatial distribution in a finite medium have been introduced as well in the general analysis. The Green's function considered in this investigation is neutron collision density in reduced variable $\epsilon = E/kT$. The Green's function above and below the source energy ϵ_s is the solution of a second-order differential equation derived from the Boltzmann transport equation with a scattering kernel applicable to the proton gas model. The effect of low energy resonance absorption and the diffusion approximation on the energy distribution of neutrons are treated as small perturbations. Mathematically, they are considered as sinks in a series of absorption events. The determination of the total collision density and therefore the energy spectrum of neutrons due to these sinks or any arbitrary sources becomes straightforward once the corresponding Green's function is known. A general solution for the Green's function up to the second order approximation has been constructed in two different ways for the cases of weak and strong absorption. Remarks on the generalization of this Green's function technique are also given. A detailed study of the effect of Doppler broadening on resonance absorption is the other remaining feature of this thesis. Many new results on the Doppler broadening functions have been derived. One of the important conclusions drawn from the study of these functions is that an overestimation on the measurement of resonance cross sections for low-lying neutron resonances at high temperature may result from the use of the conventional Doppler broadening functions instead of the generalized ones. (Diss. Abstr. Int., B)

37399 CURVED PARABOLIC MIRROR CONDENSORS FOR THERMAL AND COLD NEUTRON BEAMS. Rothbauer, R. (Univ. Frankfurt am Main). Nucl. Instrum. Methods; 101: No. 2, 221-3(1972). (In German).

Several applications and proposals for applications of total reflection of neutrons which have been discussed are referenced. Some ideas about mirror condensor systems for a neutron beam are developed. (auth)

37400 MONTE CARLO SOLUTION OF MULTIPLE SCATTERING IN COLD NEUTRON SCATTERING EXPERIMENTS. Kalli, H. (Helsinki Univ.). Nucl. Instrum. Methods; 101: No. 2, 263-6 (1972).

A Monte Carlo solution of multiple scattering in cold neutron scattering experiments is discussed. In the calculations performed free gas cross-sections with the scatterer mass A = 1, 2 and 3 are used to investigate the order of magnitude of multiple scattering in hydrogenous samples. The results seem to strengthen the assumption that multiple scattering cannot be ignored. The expected leakage probability (ELP) technique is used in the Monte Carlo solution. Some other means of reducing the variance are studied. (auth)

37401 NOTE ON THE EXISTENCE OF A MINIMUM VALUE FOR THE NEUTRON DIFFUSION LENGTH. Oeztunali, O. I.; Usseli, A. I. (Middle East Technical Univ., Ankara). Nucl. Sci., Eng.; 48: No. 2, 224-5(Jun 1972).

A minimum in the value of the neutron diffusion length is shown to exist as variations in the anisotropy change the ratio of forward scattered neutrons to backward scattered neutrons. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 36681 and 37559.

37402 (COO–3001-5) MODEL FOR SHORT RANGE CORRELATION IN THE THREE-BODY SYSTEM. Hadjimichael, E.; Yang, S. N.; Brown, G. E. (State Univ. of New York, Stony Brook. Dept. of Physics). [1972]. Contract AT(11-1)-3001. 16p. Dep. NTIS.

A method by means of which the two-body short-range correlations in the nucleon-nucleon interaction are taken accurately into account in three-body bound-state calculations is described. The method is independent of the nucleon-nucleon interaction. The method is used to calculate meson-exchange corrections to the magnetic moments of ^{3}H and ^{3}He and the Coulomb energy of ^{3}He. (auth)

37403 (ITF–72-7-P) TENSOR FORCES IN THREE- AND FOUR-NUCLEON SYSTEMS. Maksimenko, V. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

By use of perturbation theory the binding energies and the sizes of ^{3}H and ^{4}He are calculated for the interactions containing both central and tensor forces. It is established that the contribution of tensor forces to the binding energy of these nuclei is large and, in most cases, makes up more than half total energy. The calculated value of tritium binding energy turns out, as a rule, to be less than the experimental value, whereas the situation for ^{4}He is just the opposite. With no one version of forces considered it was possible to obtain an agreement between the calculated and measured values of the binding energy and the sizes of ^{3}H and ^{4}He nuclei simultaneously. (auth)

37404 (JINR–E4-6353) CALCULATION OF THE BODY-FORM FACTOR FOR THE ^{3}He AND ^{3}H NUCLEI BY MEANS OF THE MODIFIED BKR POTENTIAL. Belyaev, V. B.; Shul'ts, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 7p. Dep. NTIS (U. S. Sales Only).

On the basis of the solution of the Faddeev equation the body-form factors for the nuclei ^{3}H and ^{3}He have been calculated employing a modified Bressler–Kerman–Ruben potential. It has been found that using different hard-core radii for the singlet and triplet part of the nucleon-nucleon interaction the charge form factors have 2 minima at large q^2 and both minima are strongly marked for the ^{3}H–charge form factors. (auth)

37405 ENERGY DISTRIBUTION OF NEUTRONS INCIDENT ON A CIRCULAR DISC. Gotoh, H. (Japan Atomic Energy Research Inst., Tokai); Yagi, H.; Kobayashi, K. Nucl. Instrum. Methods; 100: No. 3, 473-6(1972).

A method for calculating the energy distribution of neutrons incident on a circular disc is described. This method is applicable to the neutrons from the reactions t–p, d–d, t–d, ^{7}Li–p, etc. When the axis of the circular disc intersects the path line of the projectile beam, the energy distribution can be represented as the product of the differential cross section of the reaction and an elementary function of the neutron energy. Numerical examples are given for the d–d neutrons. (5 figures) (auth)

37406 FORWARD PROTON–PROTON BREMSSTRAHLUNG AT 51.8 MeV. Sanada, J. (Tokyo Univ. of Education); Kondo, K.; Seki, S.; (and others). Phys. Lett.; 39B: No. 4, 509-10(15 May 1972).

The double differential cross section for the production of proton–proton bremsstrahlung with 8.5°–8.5° coplanar symmetric geometry was measured. Enhancement due to Coulomb effects was not found. (auth)

37407 MODIFIED SHELL MODEL WAVE FUNCTION AND THE BINDING ENERGY OF ^{4}He. Afzal, S. A. (Atomic Energy Centre, Dacca, Pakistan). Phys. Lett.; 39B: No. 4, 478-80 (15 May 1972).

Shell-model wave functions for ^{4}He were modified, and the binding energy was calculated and compared with other results. (auth)

37408 CHARGE ASYMMETRY IN TRANSFER REACTIONS. Ingalls, Paul David. Princeton, N. J.; Princeton Univ. (1971). 126p. University Microfilms Order No. 72-14,149.

Thesis.

Deviations from charge symmetry in the deuteron induced single-nucleon pickup reactions have been measured. Results are reported for (d,τ) and (d,t) reactions to mirror final states on self-conjugate H, He, Li, B, C, O, Ne, Mg, and Ca targets at 28.0 MeV incident deuteron energy, and for C and O at 24.0 MeV and 20.0 MeV. The two-nucleon transfer reactions (p,τ) and (p,t) at 41.8 MeV on Ca have also been measured, and show, in contrast to the former reactions, anomalously good agreement with simple charge independence. These measurements for reactions on targets not previously reported and for reactions to excited state mirror pairs provide in the process better data on some of the ground state transitions already reported, in some cases establishing deviations from charge symmetry for the first time. The observed deviations can largely be explained in a very simple treatment of surface reactions which focuses on the known (and presumably coulomb-induced) differences of proton and neutron separation energies in the target nuclei. A comparison of distorted-wave calculations which differ only in Coulomb effects also indicates that charge asymmetries are expected. It is noted, however, that in either treatment any charge asymmetry or charge dependence of the specifically nuclear (strong) force would not easily be separated from Coulomb effects. (Diss. Abstr. Int., B)

37409 BETA DECAY OF TRITIUM. Piel, William Frederick Jr. Bloomington, Ind.; Indiana Univ. (1972). 71p. University Microfilms Order No. 72-15,925.

Thesis.

The high-energy part of the beta spectrum of tritium is experimentally determined using a 40 cm.-radius-of-curvature, iron, 180-degree-focusing, shaped magnetic field spectrometer. Previous measurements using magnetic spectrometers have used an integral counter to detect the electrons. For a given momentum selection corresponding to the high-energy part of the beta spectrum, the weak intensity due to electrons properly focused by a spectrometer may be masked by spurious counts, such as background and electrons scattered from the walls, slits and baffles of the spectrometer. The present measurement incorporates a solid state detector to analyze the energy of the electrons after proper momentum selection by the magnetic spectrometer. This energy-signature technique greatly discriminates against background and scattered electrons. As a result, it is possible to determine more accurately than did previous experiments the detailed shape of the tritium beta spectrum near the spectrum end-point. An effort is made to minimize the distortion to the beta spectrum resulting from scattering in the source. The thin tritium sources used in this experiment consist of tritiated leucine which is liquid deposited onto thin lacquer backings. The spectrometer is calibrated using two low energy internal conversion lines of ^{195}Pt, whose energies are accurately known. This calibration is an improvement over previous methods since the energies of the two internal conversion lines correspond very closely to the region of interest in the tritium spectrum, thus eliminating the possibility of an incorrect calibration due to, say, remanent effects in the iron at the low magnetic field intensities. The present value of 18.578 ± 0.040 keV for the tritium endpoint energy agrees with a recent measurement of Bergkvist but disagrees with several other measurements. The data are consistent with assigning a zero rest mass to the electron's antineutrino and allow an upper limit of 100 eV/c^2, to be set assuming that degenerate neutrino and antineutrino effects are negligible. On the other hand, assuming a zero rest mass for the electron's antineutrino and that there are few degenerate antineutrinos, the data allow an upper limit of 200 eV to be set for the Fermi energy E_F of any possible sea of neutrinos and the data are consistent with $E_F = 0$ eV. (Diss. Abstr. Int., B)

37410 EFFECT OF THE QUASIFREE SCATTERING PROCESS ON THE SHAPE OF KINEMATICALLY INCOMPLETE SPECTRA AT FORWARD ANGLES IN THE DEUTERON BREAKUP. Bajzer, Z.; Paic, G. (Inst. Rudjer Boskovic, Zagreb). Fizika (Zagreb); 4: No. 2, 113-20(Apr 1972).

In the deuteron breakup the quasifree scattering (QFS) process appears alongside the final state interaction process (FSI) even at low incident energies. A preliminary calculation of the proton spectrum is presented taking into account only the n-p QFS in the D(n,p)2n reaction for $\theta = 0°$. A simple impulse approximation was used at this stage. The result shows a marked maximum at high proton energies. The importance of the QFS effect for the extraction of the n–n scattering length is discussed. (auth)

37411 PROTON SPECTRUM ANALYSIS IN THE D(n,p)2n REACTION. Skorodumov, B. G.; Gol'dberg, M. P.; Talanin, Yu. N. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 15: No. 3, 416-24(Mar 1972). (In Russian).

A spectrum of protons produced in the forward direction in the D(n,p)2n reaction at 14.06 MeV neutron energy have been measured with a telescope consisting of two gas proportional and two silicon lithium-drifted detectors. The analysis of the results with a diagram summing method have led to a following value for the neutron–neutron scattering length $a_{nn} = -23^{+3.6}_{-4.2}$ F. The influence of the method of the theoretical analysis and of the spectrometer characteristics on the value of constant a_{nn} was examined. (auth)

37412 QUESTION OF THREE PARTICLE NUCLEUS MAGNETIC MOMENTS. Krupennikova, N. B. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 15: No. 3, 466-9(Mar 1972). (In Russian).

A two particle magnetic moment operator is introduced which is explained by the velocity dependence of the nucleon–nucleon potential and is expressed in terms of nucleon spins difference. An influence of this operator on the ^{3}H and ^{3}He magnetic moments is investigated. The calculated correction turned out to be essential and has a value of 0.28 nm for ^{3}H and of −0.28 nm for ^{3}He. (auth)

37413 NEUTRON CHANNEL IN μ^--CAPTURE AND SHORT RANGE NUCLEON–NUCLEON CORRELATIONS. REACTION $\mu^- + {}^4He \rightarrow {}^3H + n + v$. Salganik, Yu. A.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 3, 518-22(Mar 1972). (In Russian).

The neutron channel from the μ^--capture by nuclei is considered on the example of the reaction $\mu^- + {}^4He \rightarrow {}^3H + n + v$. An influence of the short-range nucleon–nucleon correlations on the energy spectrum and angular distribution asymmetry is investigated. The finite state interaction and muon–nucleon Hamiltonian relativistic terms are taken into account in the calculations. The short-range correlations are shown to change considerably the high energy part of the spectrum and asymmetry, although the asymmetry energetic dependence form is not changed considerably. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 36681, 37079, 37301, 37408, 37444, 37445, 37561, and 37566.

37414 (ANU-P–529) ^{12}C(α,^{8}Be)^{8}Be REACTION. Martin, Ph.; Ophel, T. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). [1971]. 14p. Dep. NTIS (U. S. Sales Only).

The ^{12}C(α,^{8}Be(g.s.)) ^{8}Be(g.s.) reaction was re-examined between $E_\alpha = 16.5$ and 18.5 MeV. Excitation functions were measured at $90°_{cm}$ and at laboratory angles of 20° and 30°, and angular distributions were obtained at $E_\alpha = 17.4$, 17.7, 18.05, and 18.36 MeV. No evidence was found for an 8^+ level at an excitation energy near 20.8 MeV. Analysis of the angular distributions demonstrated that the highest contributing l value in the 20-21 MeV energy region is l = 6. (auth)

37415 (CEA-R–4270) STUDY OF THE ^{7}Li(d,α)^{5}He REACTION AT LOW ENERGY. Surget, Georges (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Jan 1972. 185p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

Between 0.45 MeV and 2 MeV, the ^{7}Li + d reaction, which leads to two α particles and a neutron in the exit channel, occurs with a sequential mechanism involving the ^{9}Be compound nucleus and the intermediate ^{5}He ground state. The competing mechanisms involving the first excited state of ^{5}He and the 11.4 MeV state of ^{8}Be in addition to the simultaneous emission of two ^{4}He and a neutron, have only a small effect on the yield of the reaction. Analysis, within the formalism of the R matrix, of the angular distributions of the α_1 of the first stage, the correlation between these α_1 and the α_2 emitted by ground state ^{5}He, and the ^{7}Li(d,d)^{7}Li elastic scattering, enabled the $3/2^-$ and $3/2^+$, $5/2^+$ characteristics to be attributed to the 17.28 MeV and 17.48 MeV excited states of ^{9}Be respectively. (auth)

37416 (COO–3001-7) POSSIBLE QUASI-MOLECULAR ROTATIONAL BANDS IN SD-SHELL NUCLEI. Arima, Akito (State Univ. of New York, Stony Brook. Dept. of Physics); Scharff-Goldhaber, Gertrude (Brookhaven National Lab., Upton, N. Y.); McVoy, Kirk W. (Brooklyn Coll., N. Y.). [1972]. 13p. Dep. NTIS.

Analysis of elastic ^{12}C + ^{12}C and ^{16}O + ^{16}O scattering suggests the presence of families of shape resonances, which are found to lie on rotational bands. They are compared with the corresponding ground-state bands, and alternative means of exciting them are suggested. (auth)

37417 (FRNC-TH–182) ONE OR TWO PROTON TRANSFER IN THE ^{9}Be(^{3}He,n)^{11}C* AND ^{9}Be(d,n)^{10}B* REACTIONS AT AN INCIDENT ENERGY OF 4 MeV. Deschamps, Yvon (Paris Univ., Orsay (France)). 1971. 50p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The principles of the analysis of the simple stripping of one or two nucleons in the DWBA are recalled. Results obtained for the levels of ^{10}B from the ^{9}Be(d,n)^{10}B reaction (which has a +4.91 MeV energy balance) and for ^{11}C from the ^{9}Be(^{3}He,n)^{11}C reaction (which has +7.56 MeV energy balance) are given. In both cases the incident energy was 4 MeV. Three aspects of the results are discussed: the form of the angular distributions of the neutrons associated with the populating of the different levels; spectroscopic factors; the comparison of information obtained with the most complete recent models developed for these light nuclei (intermediate interaction model of Cohen and Kurath, and the El Batononi and Kresnin model of the strongly coupled rotational state). (France)

37418 (ORNL-TM–3808) REPORT TO THE U. S. NUCLEAR DATA COMMITTEE. Good, W. M. (Oak Ridge National Lab., Tenn.). Apr 1972. 39p. Dep. NTIS.

This memo is a collection of brief reports on recent and not yet generally publicized work at ORNL which is of special interest to the USNDC. Included are abstracts of relevant ORNL reports, and papers which have been only submitted for publication. The memo covers the period of time since the last USNDC meeting. (auth)

37419 GAMMA RAYS PRODUCED BY THE INTERACTION OF 15 MeV NEUTRONS IN N, O, Mg, AND Al. Nyberg-Ponnert, K.; Joensson, B.; Bergqvist, I. (Lund Univ., Sweden). Phys. Scr.; 4: No. 4-5, 165-73(1971).

Gamma rays produced by 15 MeV neutron interactions in N, O, Mg and Al have been measured with a 7 mm Ge(Li) spectrometer. Differential γ-ray production cross sections at 80° have been determined relative to the cross section for the 4.44 MeV γ-ray line produced in ^{12}C(n,n$^-$)^{12}C. (auth) (Sweden)

37420 MASS SPECTROMETRY, CROSS SECTIONS, COSMIC RAYS. DETERMINATION OF THE FORMATION CROSS SECTIONS INVOLVED IN THE PRODUCTION OF Li, Be, AND B IN C AND O, USING MASS SPECTROMETRY. Yiou, F. (Centre National de la Recherche Scientifique, Orsay, France). Method. Phys. Anal.; 7: No. 4, 330-4(Dec 1971). (In French).

An accurate mass spectrometer method has been developed to detect small quantities of Li, Be and B (10^{-12} g to 10^{-10} g), an atomizing ion source being used. The cross sections of stable or long lived isotopes: ^{6}Li, ^{7}Li, ^{7}Be, ^{9}Be and ^{10}Be formed in C and O targets irradiated with high energy protons and α particles were thus measured. The origin of these light elements in galactic cosmic radiation can be interpreted from the results. (France)

37421 DIRECT AND NONDIRECT PICK-UP IN ^{12}C(p,d)^{11}C AT Ep = 185 MeV. Kaellne, J.; Hagberg, E. (Uppsala Univ.). Phys. Scr.; 4: No. 4-5(1971).

The reaction ^{12}C(p,d)^{11}C has been studied at $E_p = 185$ MeV. The energy of the emitted deuterons was analyzed in a magnetic spectrometer with an overall energy resolution of typically 270 keV (FWHM). Energy spectra were recorded in the angular region 2.5–50° (lab). A total of sixteen peaks were observed in the studied region of excitation energy, $E_x \leq 23$ MeV. For thirteen peaks, the measured differential cross sections are presented in the form of angular distributions which were analyzed in the DWBA. The results are compared with other experiments and calculations. The observed transitions to the 4.31 ($5/2^-$) and 8.11 ($3/2^-$) MeV states and to the unresolved doublet state (8.65 ($7/2^+$) and 8.69 ($5/2^+$)) indicate the presence of a nondirect reaction mechanism which is qualitatively discussed. (auth) (Sweden)

37422 DESTRUCTIVE INTERFERENCE IN RADIATIVE PROTON CAPTURE REACTIONS. Hasinoff, M. (Univ. of Washington, Seattle); Johnson, D.; Measday, D. F. Phys. Lett.; 39B: No. 4, 506-8(15 May 1972).

The reaction ^{12}C(p,γ_0)^{13}N was investigated for proton energies from 8.6 to 16.3 MeV (E_x = 9.8 to 17.0 MeV). Strong destructive interference is observed by levels at 11.8 and 14.0 MeV in ^{13}N. (auth)

37423 FINE STRUCTURE OF THE GIANT DIPOLE RESONANCE IN ^{16}O AND NUCLEAR COEXISTENCE. Goswami, A.; Graves, R. D. (Univ. of Oregon, Eugene). Phys. Lett.; 39B: No. 4, 499-502(15 May 1972).

It is shown that nuclear coexistence can account for most of the fine structure observed for the giant dipole resonance in ^{16}O. (auth)

37424 PUZZLE OF $\pi + {}^{12}C \rightarrow \pi + n + {}^{11}C$ REACTION RATES NEAR THE 3–3 RESONANCE. Seki, Ryoichi (San Fernando Valley State Coll., Northridge, Calif.). Nuovo Cim.; 9A: No. 2, 235-42(21 May 1972).

$\pi + {}^{12}C \rightarrow \pi + n + {}^{11}C$ reactions and the similar ones for ^{14}N and ^{16}O near the pion–nucleon 3–3 resonance are examined by means of isospin invariance. If any enhancement is assumed in a particular two-particle isospin state in the three-particle final states, three possible cases are found to yield the observed ratio of the reactions being unity. (auth)

37425 PHOTONEUTRON ANGULAR DISTRIBUTIONS IN THE GIANT RESONANCE OF ^{16}O. Jury, James William. Toronto; Univ. of Toronto (1970). National Library of Canada, Ottawa.

Thesis.

The angular dependence of photoneutron energy spectra from the $^{16}O(\gamma,n)^{15}O$ reaction has been measured for photon energies spanning the giant resonance of ^{16}O from 17 to 30 MeV. The angular distributions of the neutrons emitted in decays to the ground state of ^{15}O have been obtained with high energy resolution (typically 60 keV) using time-of-flight techniques. Photoneutron energy spectra were measured sequentially at angles of 50, 66, 82, 98, 114, 130, and 146° relative to the direction of the incident bremsstrahlung beam produced by the University of Toronto Linear Electron Accelerator. Different angles were obtained by bending the electron beam relative to a single 50 meter flight path. Angular normalization was achieved by an on-line neutron monitor above and normal to the reaction plane. Legendre polynomial coefficients describing the angular distributions were extracted as functions of excitation energy and these are seen to exhibit considerable interference effects. These coefficients are compared with the predictions of the coupled-channel reaction theories and are used to examine the composition of and interference between the states in the giant resonance. It is seen that the relative intensity of s- to d-wave neutron emission from the dipole states is less than 5% and that electric quadrupole absorption comprises only a few per cent of the ground state (γ,n) cross section. (Diss. Abstr. Int., B)

37426 WAVE FUNCTIONS OF THE NON-NORMAL PARITY STATES IN A = 15 AND 14 NUCLEI. Hsieh, S. T. (National Tsing Hua Univ., Hsinchu, Taiwan); Hsieh, S. M. Chin. J. Phys. (Taiwan); 9: No. 2, 92-7(Oct 1971).

Wave functions which span irreducible representations of the symmetry and SU(3) groups are constructed from shell-model functions of the non-normal parity states in A = 15 and 14 nuclei. (auth)

37427 COMPLETE DISRUPTION OF OXYGEN NUCLEI BY THE CAPTURE OF π^- MESONS IN NUCLEAR EMULSION. Deka, G. C.; Laskar, I. (Cotton Coll., Gauhati, India). Indian J. Phys.; 45: No. 2, 59-62(Feb 1971).

During a systematic search for nuclear interaction produced by 5 GeV antiprotons (P^-) with the nuclei of the constituents of nuclear emulsion, two interesting events were found. Each of the events was caused by the capture of π^--meson in oxygen nucleus, which disrupted completely. The probable reactions were found to be as follows: $\pi^- + {}_8O^{16} \rightarrow {}_3Li^8 + {}_2He^4 + {}_1H^3 + {}_1H^1$, and $\pi^- + {}_8O^{16} \rightarrow {}_3Li^9 + {}_2He^4 + {}_1H^2 + {}_1H^1$. (auth)

37428 INELASTIC NEUTRON SCATTERING IN THE REGION A = 11 TO 40. Nichol, L.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 6, 553-62(15 Mar 1972).

The $(n,n'\gamma)$ reaction was studied for the nuclides ^{11}B, ^{14}N, ^{19}F, ^{23}Na, ^{27}Al, ^{28}Si, and ^{40}Ca through the use of fission-spectrum neutrons. The gamma-ray spectra obtained using a Ge(Li)–NaI(Tl) split-annulus spectrometer revealed that levels up to 9 MeV are populated. Analysis of the gamma-ray spectra permitted the derivation of decay schemes and, from the branching, the primary population of each level observed. Assuming an exponential form for the reactor fission-spectrum neutrons, a model based upon the Hauser–Feshbach formalism was employed to calculate the relative population expected for each level using previously reported J^π values. The validity of the model and the reliability of obtaining spin information is examined. (auth) (Canada)

37429 RESONANCE STRUCTURE IN THE EXCITATION FUNCTION OF THE $^{19}F(d,\alpha_0)^{17}O$ AND $^{19}F(d,\alpha_1)^{17}O$ REACTIONS BETWEEN 2.34 AND 14.45 MeV. Bigler, Rodney Errol. Austin, Tex.; Univ. of Texas (1971). 164p. University Microfilms Order No. 72-15,710.

Thesis.

The $^{19}F(d,\alpha_0)^{17}O$ and $^{19}(F(d,\alpha_1)^{17}O$ reactions have been studied by measuring excitation functions in 30 keV steps over the energy range between 2.34 and 14.45 MeV deuteron energy. Cross-section data were collected simultaneously at laboratory angles of 70, 90, 120, 150, and 170°. The target material consisted of sodium fluoride. It was deposited on a carbon backing with a thickness of approximately 5 $\mu g/cm^2$. The fluorine content was 15 $\mu g/cm^2$. An array of Si(Li) drifted solid state detectors, with total system resolution ranging between 20 and 30 keV, was used in conjunction with a 40-inch diameter scattering chamber for data collection. The deuteron beam was obtained using The University of Texas tandem Van de Graaff accelerators. Depending upon the desired deuteron energy, two or three stage acceleration was used. The measured excitation functions exhibit strong resonance structures superimposed upon a direct reaction component. The total widths of the observed resonances are on the order of 500 keV FWHM. These resonance structures occur at an excitation energy of the compound nucleus ^{21}Ne ranging between 19 and 25 MeV. The width of the resonances eliminates their identification as Ericson fluctuations. A narrow region encompassing one of the strongest resonances is measured in 10 keV steps with three times the statistics in order to reveal fine structure. No evidence for fine structure greater than 10 keV is observed. A new charged particle detection system using a low dispersion sector magnet and Si(Li) drifted detectors is developed and employed in this experiment. Its major advantages are improved energy resolution, simultaneous energy and momentum information, and selectivity as to which particle groups enter the detector. The observed resonance structures are superimposed on an appreciable background which presumably is due to the direct reaction. To analyze this data a computer program has been written which treats the resonance and direct reaction components simultaneously and takes interference effects into account. (Diss. Abstr. Int., B)

37430 USE OF THE $^7Li(^7Li,2p)^{12}Be$ REACTION TO MEASURE THE GROUND STATE MASS OF ^{12}Be. Howard, Hillard Hays. Nashville; Vanderbilt Univ. (1971). 96p. University Microfilms Order No. 72-15,475.

Thesis.

The limits of particle stability and mass systematics of light nuclei have received much attention in recent years. Many extremely neutron-rich nuclei are now known to be neutron stable. However, kinematically complete experiments necessary for the determination of ground state masses have not been possible due to the lack of suitable targets necessary to reach these nuclei by common nuclear reactions. With the advent of high quality heavy ion beams one can bypass the problems of target availability and perform multinucleon transfer reaction on available targets. An example of this situation is the nucleus ^{12}Be for which the most attractive approach is to measure the proton energy spectrum from the $^{10}Be(t,p)^{12}Be$ reaction. However, targets of ^{10}Be suitable for this purpose are not yet available. An alternative to the (t,p) reaction is a Li-ion induced multinucleon transfer reaction which produces ^{12}Be as a residual nucleus. The first experimental determination of the ^{12}Be ground state mass through use of the $^7Li(^7Li,2p)^{12}Be$ reaction in a kinematically complete experiment is reported. In order to perform a kinematically complete experiment using a three-body final state reaction, the momenta of two of the three final state particles must be measured in coincidence. The kinematical relationship between these momenta allows the identification of the event as coming from a particular reaction with a particular Q-value. In the case of this experiment the detected particles are protons and their energies are measured by two detector telescopes whose positions relative to the target nucleus and the projectile momentum determine the angular factors of the protons' momenta. The Q-value of the reaction producing the two coincident protons can be calculated from the momenta and the masses of the reaction constituents. The mass excess of ^{12}Be determined in the above manner using the $^7Li(^7Li,2p)^{12}Be$ reaction is 24.95 ± 0.10 MeV. An excited state of ^{12}Be is identified at an excitation energy of 0.81 ± 0.10 MeV. The impact of this determination on predictions of particle stability and mass systematics of light nuclei is discussed. (Diss. Abstr. Int., B)

37431 ALPHA–GAMMA ANGULAR CORRELATION STUDIES OF ^{12}C AND ^{58}Ni. Eenmaa, Juri. Seattle; Univ. of Washington (1972). 193p. University Microfilms Order No. 72-15,086.

Thesis.

Angular correlations between inelastically scattered alpha particles and the subsequent de-excitation gamma rays have been measured for the excitation of the lowest 2^+ levels in ^{58}Ni and ^{12}C. Measurements on ^{58}Ni, at 23.25 MeV incident alpha energy, were performed over a large angular range in the reaction plane (defined by the normal $\vec{k}_i \times \vec{k}_f$), and in the forward hemisphere out of the reaction plane (at 40° to the normal). Measurements on ^{12}C, at 22.750 MeV incident alpha energy, were performed out of the reaction plane over a large angular range to complement the reaction-plane data determined in other experiments. The absolute angular-correlation measurements yield the magnitudes and relative phases of the transition amplitudes for excitation of the magnetic substrates ($m = 0, \pm 2$) of the 2^+ levels. Thus the total inelastic transition ($0^+ \to 2^+ \to 0^+$) is dissected into component parts which yield very detailed information about the scattering process. For ^{12}C, attempts to interpret the data in terms of the optical model and the DWBA collective model proved unsuccessful. These results are not too surprising since the inherent assumptions behind these models make their application to the ^{12}C nucleus somewhat questionable. Generally good agreement between the experimental data and theoretical predictions, however, is obtained for ^{58}Ni. Extensive optical-model analyses of the elastic scattering data yield a number of optical-model potential sets, with discrete real-well depths extending from 15 to 250 MeV, which give a good account of the elastic scattering. DWBA collective model calculations reveal that the better correspondence between inelastic scattering cross section and angular-correlation data and the theoretical predictions is obtained for the very shallow potentials. The distinctive feature of these shallow potentials (compared to successively higher potentials) appears to be a greater localization of the inelastic transition amplitudes in angular momentum space. (Diss. Abstr. Int., B)

37432 ^{3}He SPIN FLIP IN THE INELASTIC EXCITATION OF THE LOWEST 2^+ LEVELS IN ^{12}C, ^{24}Mg, AND ^{58}Ni. Patterson, Donald McCamy. Seattle; Univ. of Washington (1971). 176p. University Microfilms Order No. 72-15,128.

Thesis.

The z-axis (spin-flip) ^{3}He-gamma angular correlation in the inelastic excitation of the lowest 2^+ levels in ^{12}C, ^{24}Mg, and ^{58}Ni has been measured for 22.5 MeV ^{3}He incident on ^{12}C and ^{58}Ni, and 24.0 MeV ^{3}He incident on ^{24}Mg. The z-axis correlation was obtained by detecting the inelastically scattered ^{3}He particles in coincidence with the de-excitation gamma rays emitted perpendicular to the reaction plane. Relatively large ^{3}He spin-flip probabilities were measured for back angle scattering, particularly from ^{12}C and ^{24}Mg. The ^{3}He spin-flip probability from ^{24}Mg also has a rather large amount of structure for scattering angles forward of 150°, which is rather unusual compared to proton spin-flip measurements in this energy region. A theoretical analysis of the data has been performed using the distorted wave Born approximation collective model. The calculated results for the back angle inelastic cross sections are not in good accord with the data, indicating that the model does not provide an adequate description of the back angle scattering process. On the other hand, the shape, but not necessarily the magnitude, of the spin-flip cross section is fairly well reproduced by the calculations. In addition, a back angle spin-flip probability peak is obtained from the calculations, in reasonable agreement with the data. The height of the back angle spin-flip probability peak is strongly dependent upon the magnitude of the spin-orbit potential and relatively insensitive to the magnitudes of the other model parameters. A comparison between the calculated and measured back angle spin-flip probability.peak heights leads to the estimate that the spin-orbit potential depth appropriate for optical model analyses of ^{3}He scattering is 2.5 ± 0.5 MeV. (Diss. Abstr. Int., B)

37433 STUDY OF THE REACTION MECHANISMS OF DIRECT REACTIONS ON LIGHT NUCLEI. Werby, Michael Ferris. Tallahassee; Florida State Univ. (1971). 290p. University Microfilms Order No. 72-13,579.

Thesis.

An exact two-mode finite-range DWBA analysis was used to investigate the reaction mechanisms responsible for a representative set of direct reactions on light nuclei. The mechanisms investigated were light particle pick-up or stripping and heavy particle knock-out of the direct mode and heavy particle pick-up or stripping and light particle knock-out of the exchange mode. In addition, the distorted wave potentials that are substracted from the total interactions in the matrix elements of the exact DWBA formalism were included in calculation when all mechanisms were used. The reactions investigated were (1) ^{7}Li(^{3}He,p)^{9}Be, (2) ^{7}Li(d,t)^{6}Li, (3) d(α,t)^{3}He, and (4) ^{7}Li(^{3}He,t)^{7}Be. For reactions (1) and (2) a two-mode analysis that included the four reaction mechanisms was found to be necessary in order to describe data. For reaction (2) spectroscopic factors extracted from analysis were found to compare well with other results. Since t and ^{3}He are isobaric analogs the direct and exchange modes play almost symmetric roles in the analysis of reaction (3). For that reaction spectroscopic factors and relative motion wave functions were derived and used in the analysis. It was then possible to predict the shape and magnitude of the experimental angular distribution when all reaction mechanisms were included in the analysis. The charge exchange reaction (4) was analyzed using the heavy particle stripping and light particle knock-out mechanisms. It was possible to describe the cross section data extremely well by using both mechanisms. Spectroscopic information was extracted from the analysis and was found to be consistent over the entire range of energies analyzed. The ranges of bombarding energies of the four reactions were chosen to insure that the reactions went via a direct process. In all cases the comparison between calculation and experimental data was excellent. However the reaction mechanisms appropriate for each reaction were all found to be important factors in analysis. The study suggests that for direct reactions on nuclei in the mass region of those analyzed in this study the more sophisticated finite-range two-mode formalism is necessary. (Diss. Abstr. Int., B)

37434 POSSIBLE NUCLEAR MOLECULE AT 36.5 MeV IN ^{28}Si. Stokstad, R.; Shapira, D.; Chua, L.; (and others) (Yale Univ., New Haven). Contract AT(11-1)-3074. Phys. Rev. Lett.; 28: No. 23, 1523-5(5 Jun 1972).

A number of unusual phenomena occur in ^{16}O + ^{12}C induced reactions at E_{cm} = 19.7 MeV. An interpretation of these effects in terms of a molecular resonance is suggested. (auth)

37435 ^{14}N(d,$\vec{n}$)^{15}O REACTION AT E_d = 5.16 MeV. Fogel, R. P.; Thornton, S. T. (Univ. of Virginia, Charlottesville). Nucl. Phys.; A187: No. 3, 624-36(1972).

Neutron polarization angular distributions were measured for the ^{14}N(d,$\vec{n}$)^{15}O reaction at E_d = 5.16 MeV using the pulsed beam, neutron time-of-flight method. Eight states in ^{15}O were studied. The differential cross section for elastic scattering of deuterons from ^{14}N was analyzed using the optical-model formalism to provide initial-state wave functions for distorted-wave calculations of the ^{14}N(d,$\vec{n}$)^{15}O reactions. These calculations were compared to experimental differential cross-section and polarization data. Coulomb and spin distortions, j-dependence and reaction mechanisms were considered in the analysis. The agreement between experiment and calculation was not good for the polarizations, and several possible explanations are discussed. (auth)

37436 STUDY OF THE (π,nn) REACTION ON ^{12}C. Jain, B. K. (Bhabha Atomic Research Centre, Trombay, India). Nucl. Phys.; A187: No. 3, 513-24(1972).

Simplified expressions for the transition strength of the (π^-,nn) reaction on even-mass nuclei and for the back-to-back emission of neutrons are presented. These expressions are then used to study the effect of various factors on the transition strength and to analyze the recent available data on the ^{12}C(π^-,nn) reaction. A good agreement with the experimental data is found. (auth)

37437 EXPERIMENTAL STUDY OF ^{3}He ELASTIC, INELASTIC, AND CHARGE-EXCHANGE SCATTERING FROM ^{6}Li. Givens, R. W. (Univ. of Illinois, Urbana); Brussel, M. K.; Yavin, A. I. Nucl. Phys.; A187: No. 3, 490-500(1972).

A target of ^{6}Li was bombarded with the ^{3}He beam from the University of Illinois cyclotron. Differential cross sections for the elastic scattering, the inelastic scattering to the first two excited states of ^{6}Li, and the (^{3}He,t) charge-exchange reaction to the ground state of ^{6}Be were determined over angular ranges of approximately 20° to 115° (c.m.) at ^{3}He energies of 24.6 MeV and 27.0 MeV. (The weak inelastic transition to the 3.56 MeV state of ^{6}Li, ordinarily obscured by a background of three-body break-up, was observed by requiring a coincidence at most angles between the scattered ^{3}He and the ^{6}Li recoil.) The ratio of the integrated charge-exchange cross section between 55° and 115° to the integrated inelastic cross section for this transition (both with $\Delta T = 1$) is somewhat less than expected from isospin considerations (i.e., about 1.6 instead of 2.0). (auth)

37438 INVESTIGATION OF (p.pd) REACTION ON LIGHT NUCLEI AT ENERGY 50 MeV. Boikov, V. V.; Vel'berg, B. V.; Loshchakov, I. I.; Ostroumov, V. I. (Leningrad Polytechnic Inst.). Yadern. Fiz.; 15: No. 3, 425-8(Mar 1972). (In Russian).

The (p,pd)-reaction on ^{12}C, ^{14}N, ^{16}O nuclei was studied in an emulsion chamber which has been irradiated with 50 MeV protons. Total cross sections, secondary proton energy spectra and secondary nuclei momentum and angular distributions were obtained. An analysis of the experimental data was performed in the frame of stripping and knock-out model. (auth)

37439 NEUTRON CAPTURE CROSS SECTIONS IN F, Mg, Al, Si, P, AND S FROM 10 TO 80 keV. Nystroem, G.; Lundberg, B.; Bergqvist, I. (Foersvarets Forskningsanstalt, Stockholm). Phys. Scr.; 4: No. 3, 95-9(1971).

Neutron radiative capture cross sections have been measured in the energy region 20 to 80 keV using time-of-flight techniques and a 12.7 cm × 10.2 cm NaI(Tl) scintillator as γ-ray detector. The samples studied were natural samples of F, Mg, Al, Si, P and S. Radiative widths were determined for the resonances in ^{19}F at 27 keV (1.4 ± 0.3 eV) and 50 keV (1.5 ± 0.3 eV), in ^{24}Mg at 84 keV (4.0 ± 0.9 eV) and in ^{27}Al at 35 keV (1.9 ± 0.3 eV). Resonances were also observed in Mg at 45 keV, in Si at 38 keV and 68 keV, in P at 27 keV and in S at 30 keV and 42 keV. (auth) (Sweden)

37440 CHARGE DENSITY DIFFERENCES BETWEEN PAIRS OF ISOTONES. Gerace, W. J.; Hamilton, G. C. (Univ. of Massachusetts, Amherst). Phys. Lett.; 39B: No. 4, 481-4(15 May 1972).

Elastic electron scattering experiments have recently determined the nuclear charge densities for several pairs of isotones. It is found that the single-particle shell model can readily explain the differences between these densities even though the model does not reproduce the individual total densities well. (auth)

37441 STUDY OF ANGULAR CORRELATIONS IN REACTIONS ^{10}B$(\alpha,d_1\gamma)^{12}$C, ^{11}B$(\alpha,t_1\gamma)^{12}$C, ^{12}C$(\alpha,\alpha_1\gamma)^{12}$C. El-Kamkhavi, A. A.; Gurevich, G. S.; Orlova, N. V.; (and others). (Moscow State Univ.). Yadern. Fiz.; 15: No. 3, 429-34(Mar 1972). (In Russian).

The angular correlation functions in reactions ^{10}B$(\alpha,d_1\gamma)^{12}$C, ^{11}B$(\alpha,t_1\gamma)^{12}$C and ^{12}C$(\alpha,\alpha_1\gamma)^{12}$C were measured in the primary energy interval from 19 to 25 MeV. The measurements were carried out in the reaction plane at charge-particle production angles that corresponded to the angular distributions maxima and minima. 26 functions of the angular correlations were measured. The parameters values for the angular correlations functions were given, which were obtained from the experimental data by the least square method. (auth)

37442 STRUCTURE FACTOR OF THE ELASTIC α-PARTICLES AND DEUTERON SCATTERING FOR THE HEAVY PARTICLE STRIPPING MECHANISM. Dmitrieva, T. A.; Teplov, I. B. (Moscow State Univ.). Yadern. Fiz.; 15: No. 3, 478-82(Mar 1972). (In Russian).

The structure factor of the elastic scattering of α-particles on ^{9}Be, ^{10}B, ^{12}C, ^{14}N, ^{15}N, ^{16}O and of deutrons on the nuclei ^{12}C, ^{14}N, ^{16}O was calculated for the heavy particle stripping mechanism. This factor was shown to explain qualitatively the existence and width of the cross section maximum in the 180° region. (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 36158, 36681, 37408, 37419, 37428, 37432, 37439, 37440, 37472, and 37560.

37443 (FRNC-TH-169) STUDY OF THE REACTION ^{28}Si(p,d)^{27}Si AT 29.5 AND 45 MeV. Romero, M. (Grenoble Univ. (France). Institut des Sciences Nucleaires). 1970. 64p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The ^{28}Si(p,d)^{27}Si reaction was studied with 29.5 MeV protons, the $(5/2^+)$ ground state level and the 2.17 MeV $(7/2^+)$ level of ^{27}Si being established. Fifteen levels up to an excitation energy of 6 MeV were observed for ^{27}Si using 45 MeV protons. A generalized DWBA calculation was effected for the 2.17 MeV $(7/2^+)$ J-forbidden level of ^{27}Si. The various models currently used for the ^{28}Si, ^{27}Si, and ^{27}Al nuclei are examined. Finally, a comparison of the significance of inelastic effects and direct processes in (p,d) and (d,^{3}He) type reactions was made. (France)

37444 (FRNC-TH-176) STUDY OF PARTICLE-HOLE STATES OF N = Z EVEN-EVEN NUCLEI CORRESPONDING TO THE 2s-1d SHELL USING THE (^{3}He,d) REACTION. Kalifa, Jacques (Paris Univ., Orsay (France)). 1971. 60p. (In French). Dep. NTIS (U.S. Sales Only).

Thesis.

The following reactions were studied: ^{31}P(^{3}He,d)^{32}S, ^{35}Cl(^{3}He,d)^{36}Ar, ^{27}Al(^{3}He,d)^{28}Si, ^{23}Na(^{3}He,d)^{24}Mg, and ^{19}F(^{3}He,d)^{20}Ne, the energy of the ^{3}He projectile being 8 MeV, i.e., slightly above the Coulomb barrier energy. The experimental equipment and the methods of analysis are described. The cross sections of the levels studied at this energy enabled reasonable counting rates to be obtained. The positive energy balance of the reactions allowed excitation energies of about 10 MeV to be reached. The first spin levels and 3^- parity were observed together with compound nucleus effects. Comparisons are made between the intensities of the transitions measured for the levels of ^{28}Si, ^{32}S, and ^{36}Ar and those predicted using models. The intensities calculated using wave functions from the collective model are very different from the experimentally observed values. In contrast, the intensities calculated for ^{32}S and ^{36}Ar using wave functions of the shell model with configuration mixing agree with the results obtained. (France)

37445 (FRNC-TH-177) MEAN LIFE MEASUREMENTS BY THE STOPPING-IN-FLIGHT OF AN EXCITED NUCLEUS PRODUCED AT LOW ENERGY. THE FIRST EXCITED STATE OF ^{22}Ne IN THE ^{19}F$(\alpha,p\gamma)^{22}$Ne REACTION AT 2.9 MeV. Sztark, Henri (Bordeaux Univ. (France)). 1971. 62p. (In French). Dep. NTIS (U.S. Sales Only).

Thesis.

The first excited state of ^{22}Ne in the ^{19}F$(\alpha,p\gamma)^{22}$Ne reaction at 2.9 MeV was studied. The de-excitation radiation at 1.277 MeV was recorded in coincidence with the recoil protons in order to improve the accuracy of the measurements. Mean life measurements enabled the direct determination of the reduced transition probability to be made, and are in agreement with complementary measurements of quadrupolar moments. Such measurements provide an excellent test of the validity of existing models (deformation parameters). (France)

37446 (IAEA-TA-523) NUCLEAR PHYSICS. Report to the Government of Iraq. Demidov, A. M. (International Atomic Energy Agency, Vienna (Austria)). Mar 1970. vp. INIS.

According to the appointment by the International Atomic Energy Agency, Technical Assistance Department, the author worked for four months as an expert in the field of nuclear physics (studies on thermal neutron radiative capture) at the Nuclear Research Institute of Baghdad. A brief description of the institute itself, its structure, cadres, tasks in national economy and international cooperation is given. The lectures given by the author during his stay in the institute are listed and concrete recommendations with regard to the future work are made. The report contains the following annexes: 1. Spectra of gamma rays after thermal neutron capture in ^{30}Si and ^{34}S. 2. Cascade de-excitation of p-levels in even-odd nuclei with $21 \leq A \leq 41$ after thermal neutron capture. 3. Useful and useless experiments in nuclear physics. Annexes 1 and 2 represent full-text articles containing experimental data obtained during the author's stay in Baghdad. Annex 3 is the text of one of his lectures delivered at the Nuclear Research Institute in Baghdad at the request of Iraqi physicists. (auth)

37447 (INP-777) ELASTIC SCATTERING OF 27.5 MeV ALPHA PARTICLES ON ^{27}Al, ^{28}Si, ^{32}S, Ti, AND ^{59}Co NUCLEI AND THE r_0 DISCRETE AMBIGUITY OF THE OPTICAL POTENTIAL. Bobrowska, A.; Budzanowski, A.; Grotowski, K.; Jarczyk, L.; Kamys, B.; Micek, S.; Polok, M.; Strzalkowski, A.; Wrobel, Z. (Institute of Nuclear Physics, Krakow (Poland)). Dec 1971. 40p. Dep. NTIS (U. S. Sales Only).

Angular distributions for elastic scattering of 27.5-MeV alpha particles on ^{27}Al, ^{28}Si, ^{32}S, Ti and ^{59}Co nuclei have been measured in the angular range from 20 to 179° (lab). The experimental data were fitted with the optical model in full angular range. Many sets of four-parameter potentials, describing the elastic scattering, were found with the depths of the real part ranging from 40 to 450 MeV. A new discrete ambiguity in the optical model (namely in r_0) was observed. (auth)

37448 (LYCEN-7185) ^{21}Ne(d,p)^{22}Ne REACTION AND THE EXCITED STATES OF ^{22}Ne. Chambon, B.; Bersillon, O.; Drain, D.; Lambert, M.; Madjar, N.; Pastor, C.; Vidal, J-L.; Beaumevieille, H.; Morand, C. (Lyon Univ. (France). Institut de Physique Nucleaire). Dec 1971. 18p. (In French). Dep. NTIS (U. S. Sales Only).

The absolute differential cross sections and angular distributions for 13 proton groups from the ^{21}Ne(p,d)^{22}Ne reaction at 3.3 and 3.6 MeV were measured. The data were analyzed in DWBA theory and the associated spectroscopic factors were extracted. The results show that the $\rho_n = 0$ transfer is involved in the formation of the excited states at 6.823, 6.860, and 7.913 MeV, whereas the $\rho_n = 1$ transfer is associated with the levels at 7.402, 7.484, 7.663 and 7.720 MeV. (France)

37449 LEVELS OF ^{33}Cl VIA THE ^{32}S(d,n)^{33}Cl REACTION. Elbakr, S. A.; Glavina, C.; Dawson, W. K.; (and others) (Univ. of Alberta, Edmonton). Can. J. Phys.; 50: No. 7, 674-83(1 Apr 1972).

The ^{32}S(d,n)^{33}Cl reaction was studied at two bombarding energies of 4.70 and 5.50 MeV. The Q value of this reaction was measured to be 62 ± 9 keV. The excitation energies of the levels observed are 812 ± 4, 1993 ± 6, 2351 ± 5, 2688 ± 4, and 2851 ± 4 keV. Neutron angular distributions for transitions to these states have been analyzed with DWBA and Hauser-Feshbach theories to yield l_p values and spectroscopic factors. The l_p values for transitions to the ground, 0.812 and 2.851 MeV states are 2, 0, and 1 respectively, in agreement with previous results. The analysis also favors l_p values of 2 and 3 for transitions to the 2.351 and 2.688 MeV states respectively. The results were compared with several other experimental and theoretical investigations. (auth) (Canada)

37450 DEFORMATIONS OF GROUND-BANDS IN ^{20}Ne, ^{24}Mg, AND ^{28}Si. I. Horikawa, Yataro (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 3, 867-79(Mar 1972).

The analysis of elastic and inelastic electron scatterings from 0^+, 2^+, 4^+ states in ^{20}Ne, ^{24}Mg, and ^{28}Si is carried out within a framework of the rotational model. It is shown that a Y_4 term is necessary in addition to the usual Y_2 term in the single particle field in order to explain these transitions simultaneously. Intrinsic charge distributions are determined and quadrupole and hexadecapole charge moments of ^{20}Ne, ^{24}Mg, and ^{28}Si are evaluated to be Q_0 = 61, 67, 62 efm^2 and H_0 = 274, 45, 195 efm^4, respectively. (auth)

37451 SU(3) CALCULATIONS IN ^{24}Mg. Strottman, D. (Nuclear Physics Lab., Oxford). Phys. Lett.; 39B: No. 4, 457-60 (15 May 1972).

Results of calculations on ^{24}Mg using realistic matrix elements are presented; it is shown that SU(3) gives results superior to a truncated jj model. (auth)

37452 PRODUCTION OF NEUTRONS FROM PHOSPHORUS BY HIGH-ENERGY BREMSSTRAHLUNG. Anderson, D. W. (Univ. of Oklahoma, Oklahoma City); Petry, R. F.; Fischbeck, H. J. Radiat. Res.; 50: No. 1, 33-40(Apr 1972).

The production of neutrons from phosphorus-31 by a high-energy bremsstrahlung beam was studied using an electron synchrotron. The mass attenuation coefficient for the principal photoneutron reaction was determined as a function of photon energy to 60 MeV. It increases from zero at 12.3 MeV to a maximum of 4.1×10^{-4} cm^2/g at 20 MeV, a value which is 1.7% of the total mass attenuation coefficient at this energy. At higher energies, secondary maxima occur so that photoneutron production is appreciable to at least 60 MeV. Absorption processes with energy transfer to deep-lying nuclear shells are thought to be of major significance at the higher energies. (auth)

37453 ^{21}Ne(d,p)^{22}Ne AND EXCITED STATES OF ^{22}Ne. Chambon, B.; Bersillon, O.; Drain, D.; (and others) (Univ. Claude Bernard de Lyon, Villeurbanne, France). Nucl. Phys.; A187: No. 3, 557-67(1972).

Absolute differential cross sections for 13 proton groups from the ^{21}Ne(d,p)^{22}Ne reaction have been measured at E_d = 3.3 and 3.6 MeV with a gas cell containing ^{21}Ne. DWBA fits were applied to the data and the associated spectroscopic factors were extracted. The results indicate that l_n = 0 transfer is involved in the formation of the 6.82, 6.86 and 7.91 MeV states, whereas l_n = 1 transfer is associated with the 7.40, 7.48, 7.66 and 7.72 MeV levels. (auth)

37454 MEDIUM ENERGY INTRANUCLEAR CASCADE CALCULATIONS: A COMPARATIVE STUDY. Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR); Bertini, H. W.; Chen, K.; (and others). Nucl. Phys.; A187: No. 3, 531-44(1972).

Comparisons are reported among the Monte Carlo simulations of proton-induced intranuclear cascades as carried out by three different sets of investigators. The three sets of results for interaction of 150 and 300 MeV protons with ^{27}Al and ^{181}Ta are in excellent agreement for observable quantities such as energy spectra of emitted protons and mass-yield curves for spallation reactions. (auth)

37455 LEVELS IN ^{30}Si EXCITED BY THE ^{26}Mg(α,n)^{29}Si, ^{26}Mg(α,γ)^{30}Si, AND ^{26}Mg(α,α)^{26}Mg REACTIONS. Russell, J. P.; Taylor, W. E.; Dunnam, F. E.; Van Rinsvelt, H. A. (Univ. of Florida, Gainesville). Nucl. Phys.; A187: No. 3, 449-58(1972).

The reactions ^{26}Mg(α,n)^{29}Si, ^{26}Mg(α,γ)^{30}Si and ^{26}Mg(α,α)^{26}Mg have been investigated for E_α = 2.5–4.3 MeV. Twenty-nine resonances were observed in the ^{26}Mg(α,n)^{29}Si reaction and the total widths of the corresponding ^{30}Si levels were estimated. Three of the resonances were also seen in the ^{26}Mg(α,γ)^{30}Si reaction and their spin and parity could be determined from angular distribution data for the ground state transition. The measured resonance strengths were found to support the isobaric spin selection rule for E1 transition in self-conjugate nuclei. A multi-channel multi-level R-matrix calculation was used to analyze the elastic scattering data, yielding spin, parity and partial widths of the observed levels (auth)

37456 LIFETIME MEASUREMENTS FOR LEVELS IN ^{30}P BETWEEN 3.7 AND 4.7 MeV EXCITATION ENERGY. Nolan, P. J.; Bailey, D. C.; Carr, P. E.; (and others) (Univ. of Liverpool). J. Phys., A (London); 5: No. 3, 454-9(Mar 1972).

The mean lifetimes of nine levels in ^{30}P, between 3.7 and 4.7 MeV excitation energy, were measured using the Doppler shift attenuation method. A limit was also placed on the lifetime of one further level. Three of these lifetimes have not previously been measured; these are 40 ± 30 fs, 180^{+60}_{-50} fs and 185 ± 15 fs for the 4235, 4298 and 4343 keV levels, respectively. A doublet was found at 4229.9 ± 1.3 keV and 4234.5 ± 1.8 keV, where only a single level had been previously reported. The measured lifetimes give transition strengths which lead to spin assignments of 2^+ and 3 for the 3834 and 3927 keV levels, respectively. (auth)

Nuclear Properties and Reactions, $39 \leq A \leq 58$

Refer also to abstracts 36681, 37408, 37428, 37431, 37432, 37440, 37447, 37472, 37473, 37498, and 37558.

37457 (ANU-P-528) LIFTEIME AND γ-RAY ANGULAR DISTRIBUTION MEASUREMENTS FOR LOW-LYING LEVELS IN ^{45}Ti. Zuk, W. M.; Davidson, W. F.; Carlson, L. E.; Najam, M. R. (Australian National Univ., Canberra. Dept. of Nuclear Physics). [1971]. 23p. Dep. NTIS (U. S. Sales Only).

The decay modes, lifetimes and spins of lowlying levels in ^{45}Ti were investigated via the ^{45}Sc(p,nγ)^{45}Ti reaction. The mean lifetimes of the 1353, 1468 and 1521 keV levels were found to be 146 ± 24, 670^{+164}_{-120} and 79 ± 13 respectively, by the technique of attenuated Doppler-shifts. Lower limits of 1000 fs were set for the levels at 330, 744 and 1226 keV. Angular distributions of de-excitation γ-rays measured and compared with theoretical predictions of the compound nucleus statistical model to give spin assignments. From data obtained here and in previous experiments spins and parities were deduced for levels at 40 ($7/2^-$, $9/2^-$), 1353 ($9/2^-$) and 1468 ($11/2^-$) keV. (auth)

37458 (JINR-E4-6348) TWO-STEP DEUTERON STRIPPING ON SPHERICAL NUCLEI. Gridnev, K. A.; Lukyanov, V. K.; Semenov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 11p. Dep. NTIS (U. S. Sales Only).

The main features of the two-step effects connected with one-phonon virtual excitations are analyzed for allowed neutron transfers in the ^{52}Cr(d,p)^{53}Cr reaction. To this end the obvious expression for the cross sections obtained in the double adiabatic perturbation approach is calculated with the help of an ordinary DWBA-method. A mixture of the two-step effects to the usual one-step cross section is found to be about 1%, but with increasing incident energy from 10 to 20 MeV the effect increases approximately by a factor of 10 times. (auth)

37459 NEUTRON INDUCED GAMMA-RAY REACTIONS IN CALCIUM IN THE ENERGY RANGE $4.85 \leq E_n \leq 8.05$ MeV. Dickens, J. K. (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng.; 48: No. 1, 78-86(May 1972).

Gamma-ray spectra have been obtained for reactions involving neutron interactions with a sample of natural calcium. Gamma rays were observed which are associated with the reactions ^{40}Ca(n,n$'\gamma$)^{40}Ca, ^{40}Ca(n,pγ)^{40}K, ^{40}Ca(n,$\alpha\gamma$)^{37}Ar, and ^{42,44}Ca. Incident neutron energies were E_n = 4.85, 5.4, 6.45, 7.0, 7.5, and 8.05 MeV, and the scattering angle was θ_γ = 125 deg. The gamma rays were detected using a 45-cm^3 coaxial Ge(Li) detector placed 100 cm from the sample; time-of-flight was used with the gamma-ray detector to discriminate against pulses due to neutrons and background gamma radiation. The sample was 20 g of natural calcium metal in the form of a right circular cylinder. The incident neutron beam was produced by bombarding a deuterium-filled gas cell with the pulsed deuteron beam of appropriate energy from the ORNL 6-MV Van de Graaff. The resulting neutron beam was monitored using a scintillation counter; a time-of-flight spectrum from this detector was recorded simultaneously with the gamma-ray data. These data have been studied to obtain absolute cross sections for production of gamma rays from calcium for the incident neutron energies. More than 50 gamma rays were correlated with transitions among the residual nuclei; these assigned gamma rays have >90% of the total gamma production cross section for $E_n \leq 6.45$ MeV. All unplaced gamma rays have small cross sections and are most likely associated with transitions in ^{40}K. The cross sections have been compared, where possible, with previously measured values and with results of the most recent evaluation for calcium with generally good agreement. Several important differences with previous data are discussed. (auth)

37460 ^{54}Fe(p,d)^{53}Fe REACTION AT 52 MeV. Ohnuma, Hajime (Tokyo Univ.); Suehiro, Teruo; Ishizaki, Yoshihide; (and others). J. Phys. Soc. Jap.; 32: No. 6, 1466-71(Jun 1972).

The ^{54}Fe(p,d)^{53}Fe reaction was studied at 51.93 MeV with a magnetic spectrometer. Results were analyzed in terms of distorted wave Born approximation theory to obtain transferred l-values and spectroscopic factors. The $f_{7/2}$ spectroscopic factor for the ground state was 3.0. Unambiguous l = 1 transitions to the levels at 0.74, 2.02 and 3.74 MeV were observed. (auth)

37461 THERMAL NEUTRON CAPTURE IN ^{50}Ti AND ^{64}Ni. Arnell, S. E.; Hardell, R.; Hasselgren, A.; Mattsson, C. G.; Skeppstedt, Oe. (Chalmers Tekniska Hoegskola, Goteborg). Phys. Scr.; 4: No. 3, 89-94(1971).

The energies and intensities of gamma radiation from thermal neutron capture in ^{50}Ti and ^{64}Ni have been determined by means of a Ge(Li) pair and anti-Compton spectrometer. Internal reactor targets have been used. Decay schemes of ^{51}Ti and ^{65}Ni are deduced. The neutron separation energy of ^{51}Ti is 6 372.4 ± 1.4 keV and that of ^{65}Ni 6 098.9 ± 1.5 keV. The correlation coefficients between the (n,γ) and (d,p) strengths are −0.32 for ^{51}Ti and 0.75 for ^{65}Ni. (auth) (Sweden)

37462 1^+ STATES AND THE 1f–2p SHELL MODEL. Hansen, O. (Los Alamos Scientific Lab., N. Mex.); Nathan, O. Phys. Lett.; 39B: No. 4, 419-23(15 May 1972).

The observed 1^+ cross sections from (^{3}He,p) reactions on even Ca, Ti, Cr, and Fe targets are analyzed in terms of an approximate sum rule. It is shown that the summed 1^+ cross sections depend in a qualitative way on the proton and neutron number of the target as predicted from the shell model. (auth)

37463 REORIENTATION MEASUREMENT IN ^{56}Fe. Cameron, J. A.; Gibb, A. W.; Taylor, T.; Zamori, Z. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 5, 475-80 (1 Mar 1972).

The reorientation effect in Coulomb excitation was used to measure the static quadrupole moment of the first 2^+ level of ^{56}Fe. Using beams of ^{4}He and ^{16}O on thin highly enriched targets and observing the spectrum of scattered particles in semiconductor detectors, the ratios of inelastic to elastic cross sections were obtained directly. The measurements give $B(E2;\, 0^+ \rightarrow 2^+) = 0.111 \pm 0.006\ e^2\,b^2$ and $Q = -0.12 \pm 0.16$ or $+0.02 \pm 0.16$ b. The ambiguity arises from uncertainty in the relative signs of interfering matrix elements. For the case of He scattering, DWBA calculations were carried out to check the energy region where nuclear interaction begins to appear. (auth) (Canada)

37464 APPLICATION OF REALISTIC N–N INTERACTION AND HARTREE–FOCK INTERACTION TO FORM FACTORS FOR ONE-NUCLEON TRANSFER REACTIONS. So, Yuen Kong. Nashville; Vanderbilt Univ. (1971). 120p. University Microfilms Order No. 72-15,491.

Thesis.

In order to apply realistic N−N interactions and the results of Hartree−Fock calculations to form factor calculations of one-nucleon transfer reactions, a formalism was developed which is more convenient to work with than those employed in previous work on the same subject. It includes core excitation correctly. This formalism was then applied to the transitions of the ^{42}Ca (p,d) reaction. The result of this calculation disclosed the fact that using a realistic Hartree−Fock interaction results in form factors which are significantly different from those obtained by the conventional use of the Woods−Saxon as well as the Hartree−Fock interaction. On the other hand, it was demonstrated that the exact form of the residual interaction does not seem to be important as long as the "energy balance condition" is satisfied. The form factor for the transition to the $3/2^+$ (2.02 MeV) state of ^{41}Ca through the reaction ^{40}Ca(d,p) was also studied with different assumptions of the state vector for the ^{41}Ca state. (Diss. Abstr. Int., B)

37465 EXCITED STATES OF ^{40}Ar OBSERVED IN THE REACTION ^{40}Ar$(\gamma,n_0)^{39}$Ar. Lokan, K. H. (National Research Council, Ottawa); Sherman, N. K.; Gellie, R. W.; (and others). Phys. Rev. Lett.; 28: No. 23, 1526-9(5 Jun 1972).

27 excited states of ^{40}Ar in the energy range 10.4−12.5 MeV from the photoneutron spectrum of ^{40}Ar irradiated with 12.5-MeV bremsstrahlung were identified. These levels are probably associated with the promotion of one of the $1f_{7/2}$ valence neutrons into the continuum. The distribution of radiation strength in this region suggests the presence of a single-particle resonance in ^{40}Ar at ~10 MeV. (auth)

37466 LIFETIME AND γ-RAY ANGULAR DISTRIBUTION MEASUREMENTS FOR LOW-LYING LEVELS IN ^{45}Ti. Zuk, W. M.; Davidson, W. F.; Carlson, L. E.; Najam, M. R. (Australian National Univ., Canberra). Nucl. Phys.; A187: No. 3, 501-12(1972).

The decay modes, lifetimes and spins of low-lying levels in ^{45}Ti have been investigated via the ^{45}Sc(p,nγ)^{45}Ti reaction. The mean lifetimes of the 1353, 1468 and 1521 keV levels were found to be 146 ± 24, 670^{+164}_{-120} and 79 ± 13 fs respectively, by the technique of attenuated Doppler shifts. Lower limits of 1000 fs were set for the levels at 330, 744 and 1226 keV. Angular distributions of de-excitation γ-rays have been measured and compared with theoretical predictions of the compound nucleus statistical model to give spin assignments. From data obtained here and in previous experiments spins and parities were deduced for levels at 40 ($7/2^-$, $9/2^-$), 1353 ($9/2^-$) and 1468 ($11/2^-$) keV. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 37127, 37447, 37461, and 37498.

37467 (USIP–72-5) TRANSITION RATES IN $^{76\ 77\ 79}$Br. Ohlsson, Harriet (Stockholm Univ. (Sweden). Inst. of Physics). Apr 1972. 14p. Dep. NTIS (U. S. Sales Only).

Lifetime measurements of levels in the ^{76}Br, ^{77}Br and ^{79}Br isotopes are reported. Using the delayed coincidence technique the following half-lives were determined: ^{76}Br: $T_{1/2}$ (45.5 keV) = 1.13 ± 0.03 ns, $T_{1/2}$ (103.2 keV) = 0.5 ± 0.2 ns, $T_{1/2}$ (136.2 keV) = 0.4 ± 0.1 ns. ^{77}Br: $T_{1/2}$ (276.2 keV) = 0.09 ± 0.02 ns. ^{79}Br: $T_{1/2}$ (261.4 keV) = 0.13 ± 0.02 ns. The energy given in paranthesis denotes the second transition in a measured cascade. (auth)

37468 REDETERMINATION OF THE HALF-LIFE OF ^{87}Rb BY COMPARISON OF THE SEPARATED ISOTOPES ^{85}Rb AND ^{87}Rb. Neumann, Walter; Huster, E. (Univ., Muenster, Ger.). Z. Naturforsch.; 27a; No. 5, 862-3(May 1972). (In German).

Because of the discrepancies between different determinations of the half-life T of ^{87}Rb and the importance of T for measuring geological ages it was decided to compare the separated isotopes. All experimental errors are the same in both cases, and the difference of the counting rates has to be attributed to ^{87}Rb. In this manner T = (4.88 ± 0.10) · 10^{10}y was obtained. (auth)

37469 TEST OF STATISTICAL THEORY OF NUCLEAR REACTIONS IN CHARGE RANGE FROM 200 keV TO 800 keV. Gupta, H. V.; Chaubey, A. K.; Sehgal, M. L. (Aligarh Muslim Univ., India). Indian J. Phys.; 45: No. 2, 88-90(Feb 1971).

The statistical theory of nuclear reactions was used to calculate neutron capture cross sections of ^{75}As, ^{79}Br, ^{115}In, and ^{197}Au for neutron energies of 200 to 800 keV. The results are in close agreement with experimental data. (J.W.R.)

37470 ^{69}Ga IN THE ALAGA MODEL. Paar, V. (Univ. of Copenhagen. Inst. Ruder Boskovic, Zagreb). Phys. Lett.; 39B: No. 4, 466-8(15 May 1972).

The isotope ^{69}Ga is described in a model with coupling of a three-particle proton valence-shell cluster to the low-frequency quadrupole vibrational field. (auth)

37471 MEASUREMENT OF NEUTRON CROSS SECTIONS AND POLARIZATIONS USING THE ASSOCIATED PARTICLE METHOD. Hagengruber, Roger Louis. Madison, Wis.; Univ. of Wisconsin (1972). 123p. University Microfilms Order No. 72-11,240.

Thesis.

The associated particle method was used with the D(d,n)^{3}He reaction to produce collimated monoenergetic neutron beams. A number of cross section and polarization measurements were made to determine whether these beams would be suitable for scattering experiments, particularly at neutron energies between 8 and 14 MeV where there have been few experiments. The neutrons were produced in a 30.5 cm diameter chamber with 0.32 cm wall thickness. Targets were thin foils of deuterated polyethylene which were rotated to spread heating from the deuteron beam. The ^{3}He's were detected in a totally depleted surface barrier detector with a thickness chosen to allow good separation of the ^{3}He's from elastically scattered deuterons. Neutrons were detected in liquid hydrogenous scintillators outside the chamber. A timing resolution of about 2 nsec was obtained at count rates up to 10^6/sec in the ^{3}He detector. The polarization of the D−d neutrons was measured at θ_n = 65°, 85° and 100° for E_d = 11 MeV as a test of the experimental equipment and technique. The measured polarizations were consistent with previous data. Differential elastic cross sections were measured in 10° intervals from θ_{LAB} = 50° to 100° for 9 MeV neutrons scattered by cylindrical samples of natural copper and zirconium. Absolute cross sections were determined by placing the neutron detector in the sample position and directly measuring the neutron beam intensity. Backgrounds varied with angle from 10% to 50% of foreground count rates. The experimental data were compared with optical model calculations. The theoretical curves produced a reasonable fit to the copper data, however, while the theory reproduced the general features of the zirconium data, the extrema in the calculated curve were substantially larger than those indicated by the data. An attempt was made to measure the polarization of 11 MeV neutrons scattered elastically by copper. The low value of the neutron beam polarization and intensity made the rate of data accumulation unacceptably low for experiments where measurements are required at more than a few angles. The associated particle method was capable of producing timing resolution and count rates in cross section measurements, which were comparable to those obtained using pulsed beam time-of-flight, without requiring extensive shielding. The method was not suitable for polarization measurements above a neutron energy of about 6 MeV. (Diss. Abstr. Int., B)

37472 EXPERIMENTAL INVESTIGATION OF THE COMPETITION BETWEEN NEUTRON AND GAMMA RAY EMISSION FOWLOWING (d,d') REACTIONS. Ling, Ching Clifton. Seattle; Univ. of Washington (1971). 161p. University Microfilms Order No. 72-15,118.

Thesis.

The competition between neutron decay and gamma ray emission in the de-excitation of an excited nucleus, following a (d,d') reaction, has been studied with coincident detection of the inelastic deuteron and the emitted neutron. The experimental results, which indicate that the gamma decay channel is not unimportant up to 3-4 MeV above the neutron channel, are interpreted in terms of the spin dependent statistical theory. The most comprehensive (d,d'n) data was obtained with the target ^{61}Ni, for which various combinations of deuteron and neutron detection angles were explored. The neutron fractional yields as a function of compound nucleus excitation energy, were found to be approximately independent of both the deuteron and the neutron detection angles. Further, they could be accounted for by the spin dependent statistical theory using conventional values of neutron and gamma widths and a modified compound nuclear spin distribution, with the results being most sensitive to the spin distribution of the compound nucleus. Experimental measurements of ^{61}Ni(d,d')^{61}Ni however, showed strong forward peaking as well as variation of spectral shape with detection angle. Together with theoretical consideration, the (d,d') results indicate that direct reactions predominate in the forward angles while the compound nuclear process is probably prevalent at the back angles. Taken together, these results point to the surprising conclusion that the direct and compound nuclear reactions generate similar spin distributions. (d,d'n) results for targets of ^{25}Mg, ^{57}Fe, ^{91}Zr and ^{119}Sn were also obtained and found to be in fair agreement with the predictions of the spin dependent statistical theory. (Diss. Abstr. Int., B)

37473 FINE STRUCTURE OF AN ANALOGUE STATE IN ^{59}Co. Lindstrom, D. P. (Duke Univ., Durham, N. C. Triangle Universities Nuclear Lab., Durham, N. C.); Newson, H. W.; Bilpuch, E. G.; Mitchell, G. E. Nucl. Phys.; A187: No. 3, 481-9(1972).

Differential cross sections were measured at four angles for proton elastic scattering from ^{58}Fe at energies from 2.65–3.11 MeV. Using the TUNL 3 MV Van de Graaff accelerator and high-resolution analyzer-homogenizer system, a total resolution of 300–350 eV was achieved for thin solid targets of enriched ^{58}Fe. The analog of the $\frac{3}{2}^-$ third excited state of ^{59}Fe shows a fine structure pattern. The spectroscopic factor and Coulomb energy difference were extracted for this analog state. Spins, parities and widths were determined for approximately 125 resonances. (auth)

37474 BETA-DELAYED PROTON EMITTER ^{73}Kr. Hornshoej, P. (Univ. of Aarhus, Denmark); Wilsky, K.; Hansen, P. G.; Jonson, B. Nucl. Phys.; A187: No. 3, 637-40(1972).

The nucleide ^{73}Kr has been identified by on-line mass separation as a precursor of β-delayed proton emission. The proton branch is $(6.8 \pm 1.2) \times 10^{-3}$ proton/decay. The protons populate the ground state and also the first excited 2^+ state at 866 keV in ^{72}Se with a relative intensity of (35 ± 9)%. The value of $Q_{EC} - B_p$, where B_p is the proton separation energy for the nucleus ^{73}Br, is found to be 4.85 ± 0.30 MeV based on the fraction of proton events preceded by positron decay. (auth)

37475 DIFFERENTIAL RANGE STUDY OF THE ^{65}Cu(α,αn) REACTION AT INTERMEDIATE ENERGIES. Chang, S. K.; Porile, N. T. (Purdue Univ., Lafayette, Ind.). J. Inorg. Nucl. Chem.; 34: No. 2, 413-21(Feb 1972).

The differential ranges of the recoil product of the ^{65}Cu(α,αn) reaction were measured over the energy interval 24 to 42 MeV by means of the electrostatic collection technique. The results are compared with a Monte Carlo calculation based on the statistical theory and the use of a range-energy relation due to Lindhard, Scharff and Schiøtt as well as with a simple direct interaction model. The differential ranges at low bombarding energies are found to be consistent with a compound nuclear process. The ranges at the higher energies are smaller than the calculated values, indicating that a direct interaction mechanism is involved at energies above 35 MeV. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 36528, 37127, 37418, 37469, 37471, 37472, 37498, 37563, and 37575.

37476 (CNEA–304) ANOMALOUS ^{96}Zr RESONANCE INTEGRAL TO THERMAL ACTIVATION CROSS-SECTION RATIO AND THE NEUTRON ACTIVATION RESONANCE INTEGRAL OF ^{94}Zr AND ^{96}Zr. Ricabarra, M. D.; Turjanski, R.; Ricabarra, G. H. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1971. 21p. (In Spanish). Dep. NTIS (U. S. Sales Only).

Values of reduced activity resonance integral relative to the thermal cross section, I'/σ_0, ^{96}Zr and ^{94}Zr were determined relative to gold by measuring cadmium ratios in a reactor spectrum. Due to the anomalous characteristics of ^{96}Zr a measurement of I'/σ_0 for ^{96}Zr was undertaken in a "quasi" thermal spectrum. ^{96}Zr and ^{94}Zr activation resonance integrals were also determined by measuring the ratio of effective activation cross section of zirconium to ^{55}Mn. International Atomic Energy Agency (IAEA) calibrated gamma sources were used to determine the samples absolute activities. A lithium-drifted germanium γ-ray spectrometer was used in all cases to resolve the activities of the irradiated samples. The results for ^{96}Zr are $I'/\sigma_0 = 879 \pm 96$, $I' = 4.97 \pm 0.50$ b, and $\sigma_0 = 5.7 \pm 1.0$ mb; for ^{94}Zr $I'/\sigma_0 = 5.87 \pm 0.05$, $I' = 0.369 \pm 0.037$ b, and derived $\sigma_0 = 63 \pm 8$ mb. I'/σ_0 for ^{96}Zr is an order of magnitude or more greater than that found for stable isotopes. This suggests that almost 100% of the activation resonance integral of ^{96}Zr consists of p-neutron captures. This fact is not consistent with the present knowledge of p-strength functions in the $90 < A < 130$ mass region. (auth)

37477 (JINR–P7-6338) SOME SINGULARITIES OF ^{20}Ne AND ^{12}C ION INTERACTION WITH NUCLEI AT THE ENERGY OF 10 TO 17 MeV/NUCL. Nikolaev, V. M.; Shchegolev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The excitation functions of the reactions ^{133}Cs(^{20}Ne,4n)^{149g}Tb, ^{141}Pr(^{12}C,4n)^{149}Tb, ^{202,204}Hg(^{12}C,3,5n)^{211}Rn have been measured in the ion energy range from 10 to 17 MeV/nucl. It is determined that in the high energy region the cross sections are at least 10^3 times higher than the value predicted by the statistical model. Theoretical models that can explain these divergences are discussed. (auth)

37478 TRANSITION PROBABILITIES OF THE 35.5, 428, AND 463 keV TRANSITIONS IN ^{125}Te. Satyanarayana, G. (Andhra Univ., Visakhapatnam, India); Lakshminarayana, V.; Murty, D. S. Can. J. Phys.; 50: No. 6, 600-6(15 Mar 1972).

The lifetimes of the 35.5 and 463 keV states in ^{125}Te, populated in the beta decay of ^{125}Sb, are determined employing a time-to-pulse-height-converter arrangement. The half-life of the 35.5 keV state, determined by the slope method, yielded a value 1.51 ± 0.05 ns. The mean life of the 463 keV state, determined by the centroid-shift technique, yielded a value $(3.8 \pm 1.1) \times 10^{-11}$ s. This value is in complete disagreement with the previous delayed-coincidence results and is in agreement with the recent Coulomb-excitation experiments. The present experimental values are employed to estimate the M1 and E2 transition probabilities of the 35.5, 428, and 463 keV transitions, and are compared with the values obtained from the single-particle estimates. De-Shalit's core-excitation model is found to be not applicable for the present case. The theoretical values estimated using the wave functions of Kisslinger and Sorensen are found to be unsuitable for the estimation of the transition probabilities. The experimental values are therefore employed to obtain phenomenological wave functions for the ground, 35.5 keV, and 463 keV states. The resultant wave functions show sizable parts of the $\frac{5}{2}^+$ phonon contribution in both the ground and 35.5 ($\frac{3}{2}^+$) keV states, while the 463 keV state contains a dominant $\frac{3}{2}^+$ phonon contribution. (auth) (Canada)

37479 PRECISE ATOMIC-MASS DIFFERENCES IN THE REGION $59 \leq Z \leq 69$. Barber, R. C.; Bishop, R. L.; Meredith, J. O.; (and others) (Univ. of Manitoba, Winnipeg). Can. J. Phys.; 50: No. 1, 34-41(1 Jan 1972).

A high-resolution mass spectrometer was used to determine precise atomic-mass differences for 31 mass spectral doublets amongst the rare-earth chlorides. The precision of these determinations is in the range 0.6 μu to 3.8 μu, i.e. $(2.5 \text{ to } 25) \times 10^{-9}$. The new data, when combined with previous data from this laboratory and with the known ^{37}Cl – ^{35}Cl difference, provide mass-spectroscopically-derived connections between all naturally occurring odd-A nuclides from ^{141}Pr to ^{169}Tm and between all even-A nuclides from ^{142}Nd to ^{170}Er. (auth)

37480 DECAY OF ^{112}In. Yoshikawa, Nobuharu; Sakai, Mitsuo (Tokyo Univ.). J. Phys. Soc. Jap.; 32: No. 6, 1462-5(Jun 1972).

A study of log ft values of the beta decay of the 1^+ ground state in ^{112}In to the ground, first, second and third excited 2^+ and three excited 0^+ states in ^{112}Cd is presented. It shows successive increases in the log ft values for decays to the first and second excited 2^+ states. The small retardation of the transition to the third excited 2^+ state and the different retardations among the decays to the excited 0^+ states are discussed in terms of quasi-band conception and in reference to the relevant experimental facts of neighboring nuclei. (auth)

37481 IMPROVED GAMMA-RAY ENERGIES FOR DECAY OF ^{129}Cs. Taylor, H. W.; Singh, B. (Univ. of Toronto). J. Phys. Soc. Jap.; 32: No. 6, 1472-4(Jun 1972).

The gamma rays accompanying the decay of 32-hr ^{129}Cs have been studied with a 25 cm^3 Ge(Li) spectrometer. Transition energies have been determined with improved precision and internal consistency. Levels in ^{129}Xe were confirmed at 39.58 ± 0.05, 318.4 ± 0.1, 321.9 ± 0.2, 411.7 ± 0.2, 588.7 ± 0.1, 903.8 ± 0.8 and 946.0 ± 0.2 keV. (auth)

37482 EFFECT OF PROTON–NEUTRON INTERACTIONS ON ENERGY SPECTRA OF NUCLEI OF A ≃ 120 TO 145. Yagi, Kohsuke (Osaka Univ.). J. Phys. Soc. Jap.; 32: No. 6, 1457-61 (Jun 1972).

The location of neutron-single hole states $2d_{3/2}$, $3s_{1/2}$, $1h_{11/2}$ and $2d_{5/2}$ in neutron magic N = 82 nuclei ^{136}Xe, ^{138}Ba, ^{140}Ce, ^{142}Nd and ^{144}Sm is studied on the basis of proton–neutron interactions. The observed variations of the neutron-single hole energies of $2d_{3/2}$, $1h_{11/2}$ and $2d_{5/2}$ states relative to that of the $3s_{1/2}$ state in going from ^{135}Xe to ^{143}Sm are reproduced fairly well by the use of an interaction $V_{pn} = (V_0 + V_1\sigma_p \cdot \sigma_n)\delta(r_p - r_n)$ and of harmonic oscillator wave functions. The proton configurations which have been obtained from proton-transfer reactions on these isotones are employed in the calculations. Also the dominant features of the neutron-state structures and the proton-state structures observed in N = 82 isotones and Z = 50 isotopes are discussed from the standpoint of the proton–neutron interactions. (auth)

37483 WEAK γ TRANSITION OF ^{99m}Tc. Decombaz, M.; Gostely, J. J.; Lerch, P. (Institut d'Electrochimie et de Radiochimie, Lausanne, Switzerland). Radiochem. Radioanal. Lett.; 10: No. 2, 119-22(14 May 1972). (In French).

The weak γ transition of about 322 keV in the ^{99m}Tc decay scheme, previously reported by J. D. Jones and H. C. Griffin, was observed. The values of the energy and the intensity ratio of this transition to the 140-keV γ ray were confirmed. (auth)

37484 POSITRON DECAY OF ^{101}Pd. Ibraheim, N.; Pettersson, H. (Uppsala Univ.). Phys. Scr.; 4: No. 4-5, 161-3(1971).

The positron spectrum emitted in the decay of ^{101}Pd to ^{101}Rh has been investigated with a double-focusing spectrometer. Two positron branches were found with end-point energies (and intensities) of 776 ± 4 keV (5.95 ± 0.30%) and 488 ± 12 keV (0.41 ± 0.08% of the total decay). Both branches have log ft-values compatible with allowed transitions. The ^{101}Pd Q-value was determined to be 1982 ± 4 keV. (auth) (Sweden)

37485 IN-BEAM INTERNAL CONVERSION ELECTRON STUDIES. Courtney, William Joseph. Austin, Tex.; Univ. of Texas (1971). 92p. University Microfilms Order No. 72-15,734. Thesis.

A program to study the internal conversion electron decay of the excited states of nuclei produced by high energy proton beams obtained from a tandem Van de Graaff accelerator has been initiated. The experimental techniques necessary to detect the conversion electrons using Si(Li) detectors in the presence of a heavy charged particle background are described. The extension of the technique to include the use of a low dispersion magnetic spectrometer to separate the conversion electrons from the heavy reaction product background is also described. The experimental methods developed have been used to measure (1) the energy dependence of the proton inelastic scattering cross section populating the 0^+ first excited states of ^{90}Zr, ^{96}Zr and ^{98}Mo in the incident proton energy range of 6 to 8.5 MeV; (2) the lifetime of the ^{98}Mo(0^+, 0.736 MeV) state using a delayed coincidence technique between the inelastic protons populating the state and the conversion electrons from the decay; and (3) the energy dependence of the radiative proton capture cross section to the ^{90}Zr(0^+, 1.761 MeV) state in the incident proton energy range of 5.7 to 11.6 MeV. (Diss. Abstr. Int., B)

37486 STUDY OF THE VECTOR ANALYZING POWER AND CROSS SECTION FOR ^{90}Zr(d,p)^{91}Zr, ^{208}Pb(d,p)^{209}Pb AND ^{208}Pb(d,t) ^{207}Pb. Rathmel, Robert Day. Madison, Wis.; Univ. of Wisconsin (1972). 170p. University Microfilms Order No. 72-11,258. Thesis.

Angular distributions of the vector analyzing power and the differential cross section were measured for ^{90}Zr($\vec{d}$,p)^{91}Zr, ^{208}Pb($\vec{d}$,p)^{209}Pb, ^{208}Pb($\vec{d}$,t)^{207}Pb, and ^{208}Pb($\vec{d}$,d)^{208}Pb with 12 MeV polarized deuterons. The measurements generally spanned the angular range of 20 to 160° in the laboratory. Measurements were made on transitions leading to states of excitation energies up to 4 MeV in ^{91}Zr, 2.5 MeV in ^{209}Pb and 0.9 MeV in ^{207}Pb. An optical model analysis was performed on the ^{208}Pb($\vec{d}$,d) results. The experimental results for the (d,p) and (d,t) reactions were compared with DWBA (distorted-wave Born approximation) calculations. The DWBA calculations employed the optical model parameters obtained in this work for ^{208}Pb(d,d) and parameters from other analyses of elastic scattering cross sections and polarizations. The DWBA calculations qualitatively reproduce the measured cross section and vector analyzing power angular distributions. Transitions were observed with orbital angular momentum transfers l_n ranging from one to seven. In each of the three reactions studied, measurements were made on transitions with total angular momentum transfer $j = l_n + \frac{1}{2}$ and transitions with $j = l_n - \frac{1}{2}$, for some value of l_n. In these cases the observed dependence of the vector analyzing power measurements on j allowed unambiguous spin assignments to be made for states in the residual nuclei. For most other transitions the spin of the residual nuclear state could be determined by comparison of the DWBA calculations and the vector analyzing power measurements. The spin assignments determined in this work are in agreement with previous assignments except for some of the weak states in ^{91}Zr where the present results disagree with previous tentative assignments. DWBA calculations are made using Coulomb distortions only for the incident and outgoing particles to investigate the effects of the Coulomb field on the cross section and vector analyzing power measurements for ^{208}Pb. The vector analyzing power resulting from stripping in a Coulomb field is large and many aspects of the vector analyzing power are explained qualitatively by classical arguments. (Diss. Abstr. Int., B)

37487 INVESTIGATION OF STATES IN $^{92\ 93\ 95\ 97}$Tc AND $^{91\ 97}$Nb. Horton, John LaRoy Jr. Austin, Tex.; Univ. of Texas (1971). 138p. University Microfilms Order No. 72-15,778. Thesis.

The (d,n) reaction was chosen to study single particle proton states in ^{93,95,97}Tc and ^{91,97}Nb. The (d,n) reaction was also used to populate the isobaric analog states and to study the splitting of the analog states from their antianalogs (states with the same spin and parity but with $T = T_z$). The (d,n) reaction was performed on the Oak Ridge National Laboratory pulsed Tandem Van de Graaff accelerator with an incident deuteron energy of 12 MeV. Neutron detection was effected through time of flight techniques. States up to 6 MeV excitation energy were analyzed in the distorted wave Born approximation (DWBA). Assignment of the l-values was possible and tentative spin assignments were made on a basis of shell model arguments and comparison to (d,^{3}He) results. Spectroscopic factors were also extracted. The ^{92}Mo (^{3}He,t)^{92}Tc reaction was performed at an incident ^{3}He energy of 58.86 MeV. The reaction tritons were detected in a broad range spectrograph on nuclear emulsion plates. The isobaric analog of the ^{92}Mo ground state was observed as well as 14 low lying states. Spins and parities were assigned to a number of levels. (Diss. Abstr. Int., B)

37488 HOLE-STRENGTH VARIATIONS IN NEUTRON PICK-UP REACTIONS TOISOBARIC-ANALOG STATES IN Mo ISOTOPES. Kozub, R. L.; Youngblood, D. H. (Texas A and M Univ., College Station). Phys. Rev. Lett.; 28: No. 23, 1529-32(5 Jun 1972).

A study of isobaric-analog states excited in the (p,d) and (d,t) reactions on ^{92,94,96}Mo and in the reaction ^{98}Mo(p,d)^{97}Mo is reported. A large decrease was observed in l = 1 hole strength with increasing mass number and fluctuations in the ratios C^2S_n(p,d)/ C^2S_n(d,t). The first effect is discussed in terms of mixing with the dense spectrum of $T_<$ levels in the region of the isobaric-analog states. (auth)

37489 BETA-DELAYED PROTON EMISSION FROM HEAVY NUCLEI. I. THE OBSERVATION OF COINCIDENCES BETWEEN PROTONS AND gamma-RAYS. Hornshoej, P. (Univ. of Aarhus, Denmark); Wilsky, K.; Hansen, P. G.; Jonson, B.; Nielsen, O. B. Nucl. Phys.; A187: No. 3, 599-608(1972).

Coincidences have been detected between γ-rays and β-delayed protons emitted after the decay of very neutron-deficient nuclei. In the three cases studied the decay proceeds to the ground state with branches to the first excited (2^+) state of the even daughter nucleus of (58 ± 7)% (^{115}Xe to 709 keV in ^{114}Te), (14 ± 3)% (^{117}Xe to 679 keV in ^{116}Te), and (50 ± 10)% (^{181}Hg to 158 keV in ^{180}Pt). Upper limits of 2 and 6% can be placed on the branches to the 4^+ states of ^{114}Te and ^{180}Pt. For the cases of ^{115,117}Xe, coincidences with annihilation radiation were also observed; the measured positon/

proton ratio determines the difference $Q - B_p$, between the energy available for electron capture and the proton separation energy for the daughter. For ^{115}Xe the result is 6.20 ± 0.13 MeV, for ^{117}Xe 4.10 ± 0.20 MeV. (auth)

37490 BETA-DELAYED PROTON EMISSION FROM HEAVY NUCLEI. II. THE CALCULATION OF SPECTRAL SHAPES AND INTENSITIES IN A COMPOUND-NUCLEUS MODEL. Hornshoej, P. (Univ. of Aarhus, Denmark); Wilsky, K.; Hansen, P. G.; Jonson, B.; Nielsen, O. B. Nucl. Phys.; A187: No. 3, 609-23 (1972).

Beta-delayed proton emission from isotopes of xenon and mercury is investigated in a statistical calculation. The absolute proton intensities, the branching ratios to final levels, and the approximate spectral shapes are in good agreement with experiment if the β-strength function is assumed to be a constant with a low-energy cut-off. For the xenon isotopes an improved fit is obtained if the β-strength function is taken to have a broad peak centered at 5 MeV. This peak is tentatively interpreted as evidence for intermediate structure involving the $(g_p^{9/2})^{-1} g_n^{7/2}$ state. (auth)

37491 DECAY OF ^{93,93m}Ru AND LEVELS OF ^{93}Tc. Doron, T. A.; Lanford, W. A. (Univ. of Rochester, N. Y.). J. Inorg. Nucl. Chem.; 34: No. 2, 443-7(Feb 1972).

Nuclear energy levels of ^{93}Tc were studied in the decay of ^{93}Ru and by the ^{96}Ru(p,α)^{93}Tc reaction. A Ge(Li) spectrometer was used to detect the γ-rays following the decay of ^{93}Ru. A 680.2 keV γ-ray was assigned to this decay. The existence of a ^{93}Ru isomer with a half-life of 45^{+30}_{-20} sec was deduced from the growth in the activities of both ^{93}Tc and ^{93m}Tc. The spectrum of α particles from the ^{96}Ru(p,α)^{93}Tc reaction was observed at 120°. From this reaction new levels in ^{93}Tc at 2.29, 2.49 and 2.71 MeV and probable levels at 1.97 and 2.84 MeV were reported. A decay scheme of ^{93,93m}Ru is proposed. (auth)

37492 NEUTRON RESONANCES OF Sm ISOTOPES. Karzhavina, E. N.; Popov, A. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 3, 401-5(Mar 1972). (In Russian).

The penetration and yield of γ rays from the neutron capture for a Sm sample with various isotopic abundance were measured using the neutron spectrometer of the Neutron Physics Laboratory of JINR with 6 nsec/m resolution. Isotope identification was performed and parameters of ^{147}Sm and ^{149}Sm resonances were determined in the energy regions up to 400 eV and 250 eV, respectively. The obtained values of average separation D of resonances for ^{147}Sm and ^{149}Sm are: 7.20 ± 0.9; 2.3 ± 0.3 eV and strength functions S_0 are: $(3.7 \pm 0.8) \cdot 10^{-4}$ and $(5.1 \pm 0.9) \cdot 10^{-4}$. (auth)

37493 CROSS SECTIONS FOR THE ^{113}In(n,n′)^{113m}In AND ^{103}Rh(n,n′)^{103m}Rh REACTIONS. Pazsit,; Csikai, I. (Lajos Kossuth Univ., Debrecen, Hungary). Yadern. Fiz.; 15· No. 3, 412-15(Mar 1972). (In Russian).

(n,n′) cross sections leading to metastable states have been measured for ^{113}In at 2.8 and 14.7 MeV as well as for ^{103}Rh at 14.7 MeV neutron energies. The results are 260 ± 25, 66 ± 5 and 280 ± 25 mb, respectively. The conversion coefficient has been deduced for the decay of ^{103m}Rh: $\alpha_K = 123 \pm 14$. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 37454, 37479, 37489, 37490, and 37543.

37494 (AECD/EP-23) TOTAL NEUTRON CROSS-SECTION OF Ho. Farooque, Md.; Enayetullah, M.; Das, P. (Atomic Energy Centre, Dacca (Pakistan)). Jul 1971. 9p. Dep. NTIS (U. S. Sales Only).

Measurements of the total neutron cross section of Holmium have been made in the energy range of 14 to 19 MeV using T(d,n) neutrons emerging at 0 and 70°. The data have been compared with the opaque nucleus model which gives $R = 7.8 \times 10^{-13}$ cm as the radius of Ho. The present data along with the earlier data were used for optical model analysis using a square-well potential and a diffused-edge surface-absorption type potential. The diffused-edge type potential of Emmerich seems to agree better with the experimental data than the square-well potential. (auth)

37495 INFLUENCE OF THE RESIDUAL INTERACTION V_{PN} ON THE ROTATIONAL SPECTRUM OF THE ODD-ODD NUCLEUS ^{166}Ho. Reinecke, M.; Ruder, H.; Volz, H. (Univ., Erlangen, Ger.). Z. Naturforsch.; 27a; No. 5, 850-9(May 1972). (In German).

Starting with a model for odd-odd nuclei, which had been used in former investigations (rigid, symmetrical top for the deformed even-even core, two extra particles in a Nilsson potential), the influence of the coupling term H_c and of the residual interaction V_{PN} on the rotational spectrum of the odd-odd nucleus ^{166}Ho are discussed. It is shown that in this nucleus neither the coupling term H_c nor a pure Wigner force can explain the characteristic features of the rotational spectrum. It is therefore necessary to introduce a residual interaction V_{PN}, which contains at least a spin-spin term. The explicit calculation for the nucleus ^{166}Ho with a simple ansatz (δ-interaction with spin-spin term) already leads to a qualitative explanation of the particularities in the observed rotational spectrum. The investigations show how to get more information about the proton-neutron interaction in odd-odd nuclei. (auth)

37496 LEVEL STRUCTURE OF ^{171}Tm. Graham, R. L.; Geiger, J. S.; Johns, M. W. (Chalk River Nuclear Labs., Ont.). Can. J. Phys.; 50: No. 6, 513-28(15 Mar 1972).

The properties of the γ-ray transitions in ^{171}Tm, following beta decay of 7.5 h ^{171}Er, were studied using an iron-free $\pi\sqrt{2}$ beta spectrometer and Ge(Li) detectors, singly and in coincidence. The multipolarities of 8 lower-energy γ transitions were established from a study of L- or M-subshell-internal-conversion lines. The measured K-line intensities of 20 higher-energy transitions yield K conversion coefficients and hence additional multipolarity assignments. Gamma-ray energy measurements, together with an extensive series of gamma–gamma coincidence experiments, were used to establish the role of 59 (out of 65) γ transitions in the ^{171}Tm level scheme. Sixteen excited states are identified at energies of 5.025 $(3/2^+)$, 116.6 $(5/2^+)$, 129.0 $(7/2^+)$, 326.7* $(9/2^+)$, 424.8 $(7/2^-)$, 635.4 $(7/2^+)$, 675.7 $(3/2^+)$, 737.2 $(5/2^+)$, 822.3* $(7/2^+)$, 912.8 $(5/2^+)$, 998.6 $(7/2^+)$, 1225.5* $(3/2$, $5/2$, or $7/2^+)$, 1284.7* $(5/2^+)$, 1296.3*, 1391.2*, and 1400.5* $(5/2^+)$ keV. The asterisks indicate levels which are new or at variance with those proposed by some other workers. The coincidence data does not support a level at 861 keV proposed by two other groups of workers on the basis of energy sums. Nilsson orbital assignments are proposed and discussed for 12 levels. (auth) (Canada)

37497 MOESSBAUER-EFFECT STUDIES OF GADOLINIUM AND DYSPROSIUM NUCLEI. Rork, Eugene Wallace. Columbus, Ohio; Ohio State Univ. (1971). 162p. University Microfilms Order No. 72-15,284.

Thesis.

Mössbauer effect experiments have been carried out on the gamma-ray transitions between the ground states and the first excited states of ^{161}Dy, ^{158}Dy, and ^{158}Gd. Gamma-rays from ^{161}Dy were provided by two sources of ^{161}Tb implanted as an impurity both in Mo and in Cu, while gamma-rays from ^{158}Dy and ^{158}Gd were provided by a parent source of ^{158}Tb implanted as an impurity in molybdenum. It was expected that the ^{161}Tb and ^{158}Tb ions would be subject to neither an electric field gradient nor a magnetic field in the cubic host material. The ratio of Terbium ions to host ions in the active volume was 1 in 100. Experiments done with the 25.7 keV gamma-rays from the ^{161}Tb–Mo source at 4.2°K and at 300°K, and a Dy_2O_3 absorber at 300°K, showed that the total resonance absorption decreased by a factor of 2.3 at 4.2°K as compared with 300°K. Similar measurements on the ^{161}Tb–Cu source at 4.2°K and at 300°K, and a Dy_2O_3 absorber at 300°K, showed that the total resonance absorption decreased at 4.2°K as compared with 300°K, but by only 7%. The decrease in the recoilless gamma-ray emission fraction at low-temperature that occurs with both sources is contrary to expectations. Except in the neighborhood of a phase transition, for which there is no known evidence in molybdenum or copper anywhere near 4.2°K, the Debye model predicts an increase in recoilless emission as the temperature is decreased. In both copper and molybdenum, the ^{161}Dy hyperfine components were broadened, and by the same amount, as compared with 300°K. The ^{158}Gd measurements on the 79.5 keV transition, combined with available information on the local fields at the nuclear site, yield values for the g-factor and quadrupole moment of the first excited state, as follows: $g = 0.361 \pm .004$, $Q = 1.96 \pm .15$ barns. The results are in good agreement with other nuclear structure evidence that the state in question is a rotational state of a deformed nucleus. The recoilless emission intensity of ^{158}Gd was found to increase—by a factor of approximately 6—when the source temperature was lowered from 77°K to 4.2°K. No measurements were attempted with the source at room temperature, as no detectable recoilless emission was expected. The 99 keV first excited state of ^{158}Dy is also populated in the beta decay of ^{158}Tb. A careful search for recoilless absorption was carried out for ^{158}Dy in molybdenum at 4.2°K vs Dy_2O_3 and DyF_3; none was found. It seems reasonable to suppose that whatever mechanism is responsible for reducing the low-temperature resonant absorption intensity for ^{161}Dy in molybdenum may also have reduced the ^{158}Dy intensity below the threshold of detectability under the conditions of the experiment. (Diss. Abstr. Int., B)

37498 SYSTEMATICS AND FINE STRUCTURE OF COULOMB DISPLACEMENT ENERGIES. Seitz, H.; Zaidi, S. A. A.; Bigler, R. (Univ. of Texas, Austin). Phys. Rev. Lett.; 28: No. 22, 1465-8(29 May 1972).

Energies of isobaric-analog resonances in proton scattering on magic, transitional, and strongly deformed nuclei were measured with an accuracy of about 15 keV. A simple phenomenological formula describes the deduced Coulomb displacement energies of magic nuclei in the range A = 48 to 208 with an average deviation of 8 keV. Deviations from this formula for nonmagic nuclei are explained by the effect of nuclear deformation. (auth)

37499 COLLECTIVE STATES OF Gd ISOTOPES FROM (p,t) REACTIONS. Elze, Th. W.; Boyno, J. S.; Huizenga, J. R. (Univ. of Rochester, N. Y.). Nucl. Phys.; A187: No. 3, 473-80(1972).

The reactions ^{160,158,156,154,152}Gd(p,t) have been studied with 18 MeV protons. The angular distributions of the emergent tritons allow an unambiguous identification of l = 0 transitions and, in some cases, a classification of l = 2 transitions in terms of excitations of β- or γ-vibrations. Excited collective 0^+ states are populated with approximately 15% of the ground state strength. In the ^{154}Gd(p,t)^{152}Gd reaction which connects a deformed with a spherical nucleus, a third 0^+ state is observed at 1053 keV. The present results and previous data from (p,t) and (t,p) reactions on Sm isotopes support the interpretation of the 1053 keV state being a deformed 0^+ excited state in the spherical ^{152}Gd nucleus. (auth)

37500 MOESSBAUER-EFFECT OF THE 104-keV TRANSITION IN ^{180}W. Zioutas, K.; Wolbeck, B. (Univ., Bonn). Z. Naturforsch.; 26a: No. 6, 1088(Jun 1971).

The Moessbauer effect of the 2+ (104 keV) 0+ transition in ^{180}W has been observed. The source was ^{180}Ta which was produced by irradiation of a foil of natural tantalum by fast neutrons: ^{181}Ta (n,2n)^{180}Ta. The width of the resonance absorption line was (3.1 ± 0.8) mm/sec which corresponds to the linewidth derived from lifetime measurements. (auth)

37501 STUDY OF THE LANTHANIDE RECOIL PRODUCTS PRODUCED FROM THE INTERACTION OF HIGH-ENERGY PROTONS WITH TANTALUM NUCLEI. III. KINETIC ENERGIES AND MOMENTA OF LANTHANIDES FOR 580 MeV AND 19 GeV PROTONS. Neidhart, B.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). J. Inorg. Nucl. Chem.; 34: No. 2, 423-33(Feb 1972). (In German).

The recoil properties of about 26 lanthanide nuclides produced by the interaction of tantalum with 580 MeV or 19 GeV protons were determined by using the thick target thick catcher arrangement. The kinetic energies and the momenta of the products were found to be about equal for both energies. The values were 1 to 8 MeV and 20 to 40 (MeV · ame)^{½}, respectively. The momenta increase with $\sqrt{\Delta A}$, and the slope of the curve is given by a factor of 4.8. The curves for the F/B-values are quite different for both proton energies. This is explained by different mechanisms of formation (spallation and fragmentation). A differentiation between the formation processes on the basis of the kinetic energies and the momenta, respectively, is not possible. The values of the kinetic energies and the momenta indicate that fission as a formation mechanism can be excluded in the case of lanthanide nuclides produced by the interaction of high energy protons with tantalum. (auth)

37502 STUDY OF THE LANTHANIDE PRODUCTS PRODUCED FROM THE INTERACTION BETWEEN HIGH ENERGY PROTONS AND TANTALUM NUCLEI. IV. EXCITATION ENERGIES FOR 580 MeV AND 19 GeV PROTONS, AND BRIEF CONSIDERATIONS OF THE REACTION MECHANISM. Neidhart, B.; Baechmann, K. (Technische Hochschule, Darmstadt, Ger.). J. Inorg. Nucl. Chem.; 34: No. 3, 811-15(Mar 1972). (In German).

The mass of the residual nuclei was estimated using literature values, and the excitation energy of these residual nuclei was determined from the kinetic energies. The measured excitation energies increase with decreasing product mass. Although there is no proof for the validity of the equation applied for products not being true fission products, as well as for 19 GeV proton energy, a qualitative comparison shows nevertheless that the dependence of the excitation energy on the product mass is different for 580 MeV and 19 GeV proton energy. If interaction occurs between 580 MeV protons and tantalum, the lanthanide nuclides are formed by some other mechanism than in the case of interaction between 19 GeV protons and tantalum. The value of the excitation energies leads to no definite conclusion as to the reaction mechanism. (auth)

37503 PHOTOFISSION AND PHOTOFRAGMENTATION OF TANTALUM. Kasilov, V. I.; Mitrofanova, A. V.; Ranyuk, Yu. N.; Sorokin, P V. (Physical-Technical Inst., Moscow). Yadern. Fiz.; 15: No. 3, 406-11(Mar 1972). (In Russian).

The angular dependence of the nuclear and fission fragments produced in the interaction of high energy photons (600–1700 MeV) with Ta has been measured with mica track detectors. Nuclear fragments yield has been determined. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 37418, 37469, 37477, 37486, 37498, 37519, and 37575.

37504 PROPERTIES OF ^{209}Po AS OBSERVED IN THE DECAY OF ^{209}At. Alpsten, M. (Chalmers Tekniska Hoegskola, Goteborg); Appelqvist, Aa.; Astner, G. Phys. Scr.; 4: No. 4-5, 137-50(1971).

^{209}Po, with one neutron less and two protons more than ^{208}Pb, has been studied in the electron capture decay of ^{209}At. Most of the observed states below 2 MeV excitation can be interpreted as having dominant components corresponding either to one-neutron-hole states or to the coupling of a $p_{1/2}$ neutron hole to $(h_{9/2})^2 J \neq 0$ configurations. Several M1 and E2 transition rates were measured. These, as well as level energies, generally show good agreement with theory. The main part of the ^{209}At electron capture decay proceeds to a $^9/_2{}^+$ level at 2312 keV, which is interpreted as a core-excited state. (auth) (Sweden)

37505 HIGH-SPIN STATES IN ^{210}Po. Fant, B. (Forskningsinstitutet foer Atomfysik, Stockholm). Phys. Scr.; 4: No. 4-5, 175-81(1971).

The nucleus ^{210}Po has been studied in the ^{208}Pb(α,2nγ) reaction. New levels belonging to the $(h_{9/2},f_{7/2})$ and $(h_{9/2},i_{13/2})$ configurations have been observed. An isomeric state at 5057.6 keV is also proposed. The state is most likely formed by coupling the $(h_{9/2},i_{13/2})_{11}$-two-proton state to the first 5^- state in ^{208}Pb. (auth) (Sweden)

37506 CHARGE DISTRIBUTION DIFFERENCE BETWEEN LEAD AND BISMUTH. Sick, I. (Stanford Univ., Calif. CEN de Saclay, Gif-sur Yvette, France); Flocard, H.; Veneroni, M. Phys. Lett.; 39B: No. 4, 443-6(15 May 1972).

The difference in the ^{208}Pb and ^{209}Bi charge distributions is extracted from high-momentum-transfer electron-scattering data and is compared with results of Hartree–Fock calculations using the Skyrme interaction. (auth)

37507 ALPHA-ACTIVITY OF ^{209}Bi. de Carvalho, H. G.; de Araujo Penna, M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Lett. Nuovo Cim.; 3: No. 18, 720-2(29 Apr 1972).

The α-decay half-life of ^{209}Bi was calculated from theoretical considerations taking into account all hindering factors. A value of $T_{1/2} = 1.1 \times 10^{20}$ years was obtained. Measurements made with nuclear emulsion pellicles stored for several years confirm that earlier estimates of the order of 10^{18} years are probably low. (J.W.R.)

37508 MULTIPLET ENERGY LEVELS IN ^{209}Bi. Yeh, W. W. (Tsing Hua Univ., Hsinchu, Taiwan). Chin. J. Phys. (Taiwan); 9: No. 2, 58-61(Oct 1971).

A calculation of the energy levels of ^{209}Bi has been carried out by using the single-particle and 3^- phonon coupling, which includes the contributions from Pauli-principle violation terms. The effective mass (or energy) of the single particle level $i_{13/2}$ is also calculated by diagonalizing matrices of n particles n − 1 hole states, where n = 1, and 2. The result is in good agreement with Bertsch and Kuo's perturbation calculation. (auth)

37509 ANALYSIS OF MUONIC–ATOM ISOMER SHIFTS IN ^{209}Bi AND ^{207}Pb. Rinker, George Albert Jr. Irvine, Calif.; Univ. of California (1971). 83p. University Microfilms Order No. 72-14,662.

Thesis.

The observed muonic-atom isomer shifts in ^{209}Bi and ^{207}Pb are analyzed in terms of a single particle or hole coupled to collective vibrations of the nuclear core by means of the weak-coupling Hamiltonian of Bohr. The isomer shift is a delicate effect which is sensitive to certain details of nuclear structure. Although the data for these two nuclei are limited, they strongly suggest two conclusions: (1) that vibrational excitation is not strictly volume conserving, but results in a slight increase of nuclear volume; and (2) that the proton core reacts significantly to changes in state of the valence particle, in a way which is not accounted for by the present model. This reaction is found to be stronger in the case of a valence neutron than in the case of a valence proton. In addition, the Ford–Wills radial moment analysis is found to be adequate for the analysis of isomer shifts, though the refined method of Barrett is superior. As a byproduct of this work, nuclear wave functions are obtained which may be useful for other applications. A discussion of the numerical solution of the radial Schrödinger equation by Hamming's method is given, and the formulas necessary to diagonalize Bohr's nuclear Hamiltonian are obtained. As a matter of somewhat related interest, a means is given of accurately evaluating the vacuum polarization potential of order α for muonic atoms. (Diss. Abstr. Int., B)

37510 ENERGY LEVELS IN ^{193}Ir. Price, R. H.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; A187: No. 3, 641-71(1972).

The β-decay of ^{193}Os has been studied using Ge(Li) detectors singly and in coincidence to determine the energies and intensities of sixty-six transitions in ^{193}Ir. The energies and intensities of the internal conversion lines associated with the stronger transitions have been determined and used to establish multipolarities and mixing ratios. Coulomb excitation has been performed using oxygen ions ranging in energy from 25 to 65 MeV and $B(E2)\uparrow$ values have been determined for six states. The results are expressed in terms of a level scheme for ^{193}Ir with energies (in keV), spins and parities as follows: 0 $(3/2^{+})$, 73.012 $(1/2^{+})$, 80.19 $(11/2^{-})$, 138.892 $(5/2^{+})$, 180.01 $(3/2^{+})$, 299.32 $(7/2^{-})$, 357.7 $(7/2^{+})$, 361.81 $(5/2^{+})$, 460.48 $(3/2^{+})$, 521.8 $(9/2^{+})$, 557.30 $(1/2^{+})$, 559.21 $(5/2^{+})$, 598.04 $(3/2^{-})$, 621.0 $(7/2^{+})$, 695.06 $(5/2^{+})$, 712.07 $(3/2^{+})$, 740.20 $(5/2^{-})$, 848.84, 874.36, 964.27 and 1077.8. A comparison of the transition probabilities in ^{191}Ir and ^{193}Ir is presented. (auth)

37511 EXPERIMENTAL STUDIES OF THE ^{209}Bi(p,n)^{209}Po (IAS) REACTION. Hoffmann, G. W.; Dunlop, W. H.; Igo, G. J.; (and others) (Univ. of California, Los Angeles). Nucl. Phys.; A187: No. 3, 577-92(1972).

Relative neutron angular distributions have been measured for the ^{209}Bi(p,n)^{209}Po(IAS) charge-exchange reaction at 28, 35 and 45 MeV bombarding energies using a $\tilde{p}$-n timing technique. In the distorted-wave Born approximation the complex form factor extracted from the isospin-dependent part of the Becchetti–Greenlees optical-model potential gave excellent fits to the shapes of the $(p,n)_{IAS}$ angular distributions. The proton decay ($\tilde{p}$) of the IAS correlated to neutron angle was measured to be isotropic at 28 and 35 MeV, supporting the assumption that the $(p,n)_{IAS}$ reaction is pure charge-exchange in nature. The $(p,n\tilde{p})$ non-coincidence excitation function was measured from threshold to 44 MeV. A broad structure a few MeV above threshold and a decreasing cross section at higher energies were observed. The DWBA calculations did not fit this excitation function. (auth)

37512 CONTRIBUTION OF DETOUR TRANSITIONS TO INTERNAL BREMSSTRAHLUNG SPECTRUM OF ^{204}Tl. Powar, M. S.; Singh, M. (Punjabi Univ., Patiala, India). J. Phys., A (London); 5: No. 3, 460-7(Mar 1972).

The internal bremsstrahlung spectrum of ^{204}Tl was studied experimentally in a photon energy interval of 0.15 to 1.45 mc^2. The experimental photon distribution was found to agree with some of the earlier experiments in this energy region, but disagrees with recent measurements of Singh and Al-Dargazelli (Phys. Rev. 3: 364(1971)) in the entire energy region. The present experiments do not confirm theoretical predictions of Ford and Martin (Nucl. Phys. A 134: 457(1969)) regarding the contribution of detour transitions in the intermediate photon energy region. Direct transition KUB Coulomb corrected Nilsson theory (Ark. Fys. 10: 467(1956)) is found to be quite adequate in this region. Excess photon yields in the low and high energy regions of the spectrum observed in these experiments are not explained by the presently available theories. This points to the need for more accurate theories of IB spectra which take into account the Coulomb effects more precisely. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 36190, 37418, and 37557.

37513 (AWRE-O-13/72) FISSION CROSS SECTION OF ^{238}Pu FROM PERSIMMON. Moat, A. (Atomic Weapons Research Establishment, Aldermaston (England)). Mar 1972. 30p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

The neutron induced fission cross section of ^{238}Pu has been measured from 17 eV to 1 MeV using neutrons in a collimated beam from the underground nuclear explosion Persimmon. A thin deposit of ^{238}Pu was located in the beam, together with flux and background monitors. Their reaction rates were recorded as functions of time and used to determine the ^{238}Pu fission cross section as a function of energy. Data presented here were determined from fission fragments emitted at 90° to the neutron beam. (auth) (UK)

37514 (FRNC-TH-165) STUDY OF TERNARY FISSION OF ^{235}U INDUCED BY RESONANCE NEUTRONS. Barreau, Gerard (Bordeaux Univ. (France)). 1971. 52p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Certain aspects of the statistics of the ternary fission of ^{235}U by resonance neutrons are reviewed. Time-of-flight measurements used in conjunction with the 60 MeV linear electron accelerator, and the detection technique adopted for the experiment (gas scintillation detection) are illustrated. The experimental results are analyzed. It is very probable that the observed fluctuations represent a variation in the emission probability and in the energy spectrum of long range α particles. (France)

37515 FISSION FRAGMENT ENERGY LOSS AND SPECTRUM PARAMETER CHANGES FOR ^{252}Cf SOURCES OVERCOATED WITH CARBON AND GOLD. Adair, H. L. (Oak Ridge National Lab., Tenn.). Nucl. Instrum. Methods; 100: No. 3, 467-72(1972).

The self-transfer properties of ^{252}Cf sources in a vacuum environment necessitates the use of thin cover layers if the ^{252}Cf sources are to be used in fission fragment experiments or if the amount of ^{252}Cf on the sources is determined by low-geometry alpha or fission fragment counting. The thin cover layers prevent the transfer of the ^{252}Cf to surrounding areas without seriously degrading the fission fragment spectrum. This paper describes how thin carbon and gold cover foils affect the fission fragment energy, fission fragment spectrum parameters, and transfer rates from ^{252}Cf sources. (6 figures, 4 tables) (auth)

37516 CORRELATION BETWEEN THE EXCITATION ENERGIES OF TWO COMPLEMENTARY FRAGMENTS IN THE SPONTANEOUS FISSION OF ^{252}Cf. Signarbieux, C.; Poitou, J.; Ribrag, M.; Matuszek, J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 39B: No. 4, 503-5(15 May 1972). (In French).

The correlation between the excitation energies of complementary fission fragments was determined as a function of mass ratio. Contrary to results published by other authors, the present data show that these energies are completely uncorrelated for most mass pairs. (auth)

37517 DEPENDENCE OF MASS FISSION ASYMMETRY ON THE COMPOUND EXCITATION ENERGY. Adeev, G. D.; Cherdantsev, P. A. (Tomsk Polytechnic Inst., USSR). Phys. Lett.; 39B: No. 4, 485-8(15 May 1972).

The influence of the excitation energy of a compound fissioning nucleus on the potential deformation energy as a function of the fission and asymmetry coordinates was investigated. The Fermi distribution of nucleons at a certain temperature is assumed and taken into account in the Strutinsky shell-correction method. It was found that the structure of the potential energy surface becomes smoother with increasing excitation energy and shell effects disappear at a compound-nucleus temperature of 2.0 to 2.5 MeV. (auth)

37518 RADIATION OF ABNORMALLY LONG RANGE EMITTED BY VARIOUS RADIOACTIVE SOURCES. Ader, Marie. Compt. Rend., Ser. B; 274: No. 3, 200(17 Jan 1972). (In French).

The already known weak emission of very long range particles by certain radioactive sources appears to be in agreement with observations of giant pleochroic annuli made in the United States. These sources may be due to superheavy elements. (France)

37519 EFFECTS OF UO$_2$ DEPOSIT THICKNESS ON FISSION-FRAGMENT DOUBLE-KINETIC-ENERGY MEASUREMENTS. Lerche, R. A.; Wehring, B. W.; Wyman, M. E. (Univ. of Illinois, Urbana). Nucl. Instrum. Methods; 101: No. 2, 287-93(1972).

The findings of an experiment which was done to study the effect of thick source deposits on the results of fission-fragment double-kinetic-energy experiments are reported. A thin UO$_2$ deposit (5 μg/cm^2) and two thick UO$_2$ deposits (260 and 375 μg/cm^2) on thin nickel backings (90 μg/cm^2) were used in the study. The effect of source deposit thickness on pulse-height spectra, detector energy calibration, and fission-fragment mass, energy, and timing resolution are examined. The experimental results indicate that the detector calibration technique, which was used effectively, compensates for fragment kinetic energy loss in the thick source deposits. The fission-fragment kinetic energy resolution of the system using the thick foils is estimated to be 3.2 MeV and 6.0 MeV fwhm. Estimates of the mass resolution for the system are 5.5 amu and 7.2 amu fwhm. These results indicate that low count rate experiments which require correlation of either fragment mass or kinetic energy with other quantities might advantageously use thicker source deposits without severe loss of mass and energy resolution capability. (auth)

37520 ASYMMETRIC FISSION IN THE TWO-CENTER MODEL. Mustafa, M. G. (Oak Ridge National Lab., Tenn.); Mosel, U.; Schmitt, H. W. Phys. Rev. Lett.; 28: No. 23, 1536-40(5 Jun 1972).

Four-dimensional potential energy surfaces have been calculated in the asymmetric two-center model for ^{252}Fm, ^{258}Fm, ^{264}Fm, and ^{236}U. Symmetric fission is found to be preferred in ^{258}Fm, consistent with a recent observation; symmetric mass division is strongly preferred in ^{264}Fm. Asymmetric fission is preferred in ^{252}Fm, and in ^{236}U for which the fission path is investigated in more detail. The development of asymmetry in the fission of ^{236}U is described. (auth)

37521 COLLECTIVE STATES OF ^{232}Th, ^{238}U, AND ^{242}Pu. Elze, Th. W.; Huizenga, J. R. (Univ. of Rochester, N. Y.). Nucl. Phys.; A187: No. 3, 545-56(1972).

Energy levels of ^{232}Th, ^{238}U and ^{242}Pu have been studied through inelastic scattering of 16 MeV deuterons. Inelastic scattering cross sections were measured at 90 and 125° by means of a magnetic spectrograph. In all three of the nuclei studied, the ground state rotational bands were excited up to the 8^+ member. Several octupole-vibrational states were also identified in each nucleus. In ^{232}Th and ^{238}U, $K = 0^+$ (β-) and $K = 2^+$ (γ-) vibrations were observed. Relative reduced transition probabilities B(E2) and B(E3) were deduced from the (d,d′) cross sections. The B(E3, $0^+ \rightarrow 3^-$) values agree reasonably well with results of a microscopic theory of octupole vibrations that includes Coriolis coupling between the negative-parity bands. (auth)

37522 NUCLEAR CHARGE DISTRIBUTION OF THE CHARGED PARTICLE FISSION OF ^{238}U. Choppin, G. R.; Kandil, A. T. (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem.; 34: No. 2, 439-42(Feb 1972).

The distribution of nuclear charge in the fission of ^{238}U by protons of 11.2 MeV and deuterons of 10.6 MeV energy was studied using Ge(Li) spectroscopy. Using the criteria of a Gaussian charge dispersion curve it was found that the postulate of minimum potential energy best described the data in both systems, although the proton data were fitted almost as well by the postulate of equal charge displacement. (auth)

37523 THERMAL-NEUTRON FISSION CROSS SECTION AND FISSION RESONANCE INTEGRAL OF ^{254}Es. MacMurdo, K. W.; Harbour, R. M. (E. I. du Pont de Nemours and Co., Aiken, S. C.). J. Inorg. Nucl. Chem.; 34: No. 2, 449-51(Feb 1972).

The fission resonance integral and the thermal neutron fission cross section of ^{254}Es were measured using plastic fission track recorders. The cross sections were also calculated from direct experimental determinations of the fission rate of ^{254}Es compared to that of a ^{249}Cf standard. The measured values for ^{254}Es were: $I_f = 2200 \pm 90$ b (0.625 eV cutoff) and $\sigma_f = 2830 \pm 130$ b. (auth)

37524 EFFECT OF (α,n) REACTIONS ON THE RATIO OF INDUCED FISSION TO SPONTANEOUS FISSION IN NATURAL URANIUM. Attrep, Moses; Sherwood, D. J. (East Texas State Univ., Commerce). J. Inorg. Nucl. Chem.; 34: No. 2, 435-8 (Feb 1972).

The effect of beryllium as a representative low Z element on the change of the ratio of induced fission to spontaneous fission in natural uranium is significant. For systems containing 0.05 and 0.10% Be with respect to uranium the induced to spontaneous fission ratio was measured as 1.57 and 3.48, respectively. The increase in the neutron flux is attributed to (α,n) reactions on beryllium. (auth)

37525 ENERGETIC BALANCE FOR REACTION OF A NUCLEAR FISSION WITH HEAVY IONS. Karamyan, S. A.; Nguyen Tak An; Sharifov, K. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 3, 435-43(Mar 1972). (In Russian).

The values of the $\bar{\nu}$-number were measured for ^{238}U, ^{209}Bi, ^{197}Au fission with accelerated ions ^{12}C, ^{16}O, ^{22}Ne and ^{40}Ar. Using the published data on the kinetic energies and mass distributions of the fission products, the total energy balance of the above reactions was calculated. In the limit of experimental accuracy the measured $\bar{\nu}$ number values were consistent with energy conservation. The elaborated methods of the energy balance calculation can be used in the calculations of $\bar{\nu}$ number for fission reactions for which there are no experimental data. The energy balance of a hypothetical spontaneous fission is considered for $Z < 90$. It is found that the spontaneous fission mechanism for $Z < 84$ nuclei should differ considerably from the usual one. (auth)

37526 RETARDED FISSION OF SOME NEUTRON-DEFICIENT NUCLEI. Skobelev, N. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 15: No. 3, 444-7(Mar 1972). (In Russian).

A possible explanation of the nature of the spontaneously fission products having half-life ~60 sec, 1.4 min, and 2.6 min associated with decay of the isotopes ^{228}Np(^{227}Np), ^{232}Am, and ^{234}Am respectively is analyzed. The observed sharp increase of the fission probability of these nuclei may be explained with a retarded fission of the corresponding daughter excited uranium and plutonium nuclei produced by the electron capture in the mother nuclei ^{228}Np, ^{232}Am and ^{234}Am. (auth)

37527 FISSION-NEUTRON SPECTRA MEASUREMENTS OF ^{235}U, ^{239}Pu, AND ^{252}Cf. Werle, H.; Bluhm, H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Energy; 26: No. 4, 165-76(Apr 1972).

The fission-neutron spectra of ^{235}U, ^{239}Pu and ^{252}Cf were experimentally studied using proton-recoil proportional counters and ^{3}He-semiconductor-sandwich-spectrometers. The spectra and the average energies as determined by both techniques agreed within the experimental errors. The spectra were described quite well by Maxwellian distributions. The average energies deduced from the Maxwellian fits were consistent with most previously reported microscopic results and amounted to 1.956 (2.020), 2.136 (2.075) and 2.155 (2.130) MeV for ^{235}U, ^{239}Pu and ^{252}Cf, the numbers in brackets referring to the ^{3}He,-spectrometer values. (auth)

Nuclear Theory

Refer also to abstracts 36187, 37275, 37278, 37517, 37525, and 37796.

37528 (ANL/HEP-7208(Vol.1), pp 330-41) MIRROR ASYMMETRY AND SECOND CLASS CURRENTS. Lipkin, H. J. (Weizmann Inst. of Science, Rehovoth (Israel). Argonne National Lab., Ill. National Accelerator Lab., [Batavia], Ill.). 1971.

In Planning for the future. Zero Gradient Synchrotron workshops, summer 1971.

Mirror symmetry is reviewed using boron-12 and nitrogen-12 beta decay as an example. Then the theory of second-class currents for mirror asymmetry in nuclear beta decays is treated. (J.F.P.)

37529 (COO-3001-6) MODIFICATION OF HAUSER-FESHBACH CALCULATIONS BY DIRECT-REACTION CHANNEL COUPLING. Kawai, Mitsuji (State Univ. of New York, Stony Brook. Dept. of Physics); Kerman, A. K. (Massachusetts Inst. of Tech., Cambridge. Dept. of Physics); McVoy, K. W. (Los Alamos Scientific Lab., N. Mex. Indiana Univ., Bloomington. Dept. of Physics). [1971]. Contract AT(11-1)-3001. 23p. Dep. NTIS.

If open channels are strongly coupled by direct reactions, the traditional Hauser–Feshbach method of calculating fluctuation cross sections is invalid, because of non-statistical correlations which the direct channel-coupling induces between resonance partial widths in different channels. The fluctuation cross sections can still be computed from the optical S-matrix elements, however, and the formulas necessary for doing so are obtained here with the aid of an "optical background" representation of the full S-matrix. The resulting compound-elastic cross section is increased over the Hauser-Feshbach expression by a factor of 2($\Gamma \gg D$) or 3($\Gamma \ll D$) in the large-N limit, and compound-reaction cross sections are increased by roughly a factor of $(N + 1)/N$, where N is the number of directly-coupled open channels. (auth)

37530 (INP–744) COMPUTING PROGRAMMES FOR STRONG ABSORPTION MODEL "KENUT" AND "ZOLW." Makowska-Rzeszutko, M.; Pytkowicz, G. (Institute of Nuclear Physics, Krakow (Poland)). 1971. 31p. (In Polish). Dep. NTIS (U.S. Sales Only).

The program KENUT calculates differential cross sections of elastic scattering and total reaction cross section for given values of parameters of the Springer-Harvey model. The program ZOLW finds the best values of parameters by means of a phenomenological method. Both programs are written for the UMC-1 computer. (auth)

37531 (ITF-71-76-P) DESCRIPTION OF THE NUCLEAR REACTIONS USING THE QUASI-PARTICLE FORMALISM. Zakhar'ev, B. N.; Niyazgulov, S. A.; Rybarska, V.; Fenin, Yu. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

A scheme for describing scattering processes in the frame of a single theory of nuclear reactions in the representation of secondary quantization is presented. Such an approach allows the methods of microscopic theory of nuclear structure (random phase approximation, etc.) to be applied for the problems of the continuum. (auth)

37532 (ITF-71-79-P) MODEL OF THE EQUATIONS OF NUCLEAR PHYSICS. Baz, A. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 38p. (In Russian). Dep. NTIS (U. S. Sales Only).

By using the interpolation approach to the many-nucleon problem a system of equations is obtained which is applicable for describing the nuclear bound states and solving the problems of the continuous spectrum (nuclear reactions). (auth)

37533 (ITF-71-110-E) CORRELATION EFFECTS IN FEW-NUCLEON SYSTEMS. Simenog, I. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 18p. Dep. NTIS (U. S. Sales Only).

A review of the methods used in the theory of light nuclei is presented. One version of iteration-variational procedure as applied to the bound states of three- and four-particle systems is discussed in detail. (auth)

37534 (ITF-71-134-P) DERIVATION OF THE EQUATIONS OF THE COLLECTIVE BOHR–MOTTELSON MODEL ON THE BASIS OF MANY PARTICLE HAMILTONIAN. I. Dzyublik, A. Ya.; Ovcharenko, V. I.; Steshenko, A. I.; Filippov, G. F. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 38p. (In Russian). Dep. NTIS (U. S. Sales Only).

The possibility of the basic propositions of the shell model for N-particle system by using the basis functions of the rotation group representations in an α (N-1)-dimensional space is investigated. The use of 3N-9 Eulerian angles giving the orientation of three mutually orthogonal vectors in this space, and 6 collective variables characterizing the shape, dimensions, and orientation of the system in a usual space enables one to obtain a simple expression for the Hamiltonian. The transformation of a classical kinetic energy to the new variables is discussed in detail. (auth)

37535 (JINR–P4-6307) LOW-LYING 2^+ AND 3^- STATES IN EVEN–EVEN SPHERICAL NUCLEI. Vdovin, A. I.; Stoyanov, Ch.; Shirikova, N. Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

The lowest 2^+ and 3^- states of spherical nuclei have been investigated in the framework of a semimicroscopic approach using the Hamiltonian including pairing and multipole-multipole forces. The investigations were performed both in harmonic and unharmonic approximations. In the last case the interaction of oscillations of different multipole orders with each other and with the uncollective excitation branches is taken into account. For the studied states the energies are calculated as well as the quadrupole moments and probabilities of electrical transitions to the ground state. (auth)

37536 (JINR–P4-6345) ON THE INFLUENCE OF CHANGES IN EQUILIBRIUM DEFORMATIONS OF EXCITED STATES OF ODD-MASS DEFORMED NUCLEI ON THEIR STRUCTURE AND ENERGY. Arsen'ev, D. A.; Pashkevich, V. V.; Solov'ev, V. G.; Fedotov, S. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

The influence of changes in equilibrium deformations of nonrotational excited states on the energy and structure of these states is studied. It is shown that the account of $\beta_1 \neq \beta_0$ effect leads to the better agreement of calculated energies for 505↑, 541↓ and 404↓ states with experiment. (auth)

37537 (JINR–P4-6346) MODEL DESCRIBING THE STRUCTURE OF HIGHLY EXCITED STATES OF DEFORMED NUCLEI. I. Solov'ev, V. G.; Malov, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 36p. (In Russian). Dep. NTIS (U. S. Sales Only).

A model is suggested for description of highly excited states. The model is based on the account of the interaction of quasiparticles with phonons and serves to show the complication of the structure of states and the growth of their density with the increasing excitation energy. The density of ${}^1\!/_2{}^+$ state and their structure at the coupling energy of a neutron are analyzed. (auth)

37538 (JINR–P4-6367) ROTATIONAL INVARIANCE, INERTIA MOMENTS, AND 1^+ STATES IN DEFORMED NUCLEI. Pyatov, N. I.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

A rotationally invariant Hamiltonian, used for description of deformed nuclei, is reconstructed in the boson approximation with the aid of the Marshalek and Weneser method. A connection is established between the moment of inertia of the system and the properties of 1^+ excitations in it. (auth)

37539 NUMBER-CONSERVING ALGEBRAIC METHOD FOR PAIRING THEORY. Pang, Sing Chin (Carnegie-Mellon Univ., Pittsburgh); Klein, Abraham. Can. J. Phys.; 50: No. 7, 655-60 (1 Apr 1972).

Several powerful approaches to the study of pairing interactions are based on the relation of seniority conservation to the number-nonconserving algebra of quasi spins. An algebraic number-conserving treatment is developed utilizing the simplest number-conserving algebra, nonlinear under commutation, which follows from the quasi-spin algebra. The development is carried out in detail for a two-level model and yields encouraging numerical results in the simplest viable approximation consistent with the limit of strong pairing interaction. (auth) (Canada)

37540 SURFACE DISTRIBUTIONS OF ALPHA PARTICLES FROM ODD-A NUCLEI. Ahooja, R.; Sharma, R. C. (Sir George Williams Univ., Montreal). Can. J. Phys.; 50: No. 7, 622-9 (1 Apr 1972).

The alpha distributions on the nuclear surface are calculated for a number of odd-A alpha-emitting nuclei by an approximate method based on Nosov's work. The calculations are limited to alpha partial waves of $1 \leq 4$. An inspection of distributions shows little variation with A, unlike the distributions in the case of even-even alpha emitters. The lack of variation is interpreted as due to the screening influence of the unpaired odd nucleon. It is also concluded that there exists a possibility of significantly large relative phases between alpha waves before penetration of the barrier in odd-A nuclei. (auth) (Canada)

37541 POSSIBLE EXISTENCE OF I^+ RESONANCE IN CHARGE EXCHANGE REACTIONS OF SPHERICAL NUCLEI. Gaponov, Yu. V.; Lyutostanskii, Yu. S. JETP Lett. (USSR) (Engl. Transl.); 15: No. 3, 120-2(5 Feb 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 3, 173-5(5 Feb 1972).

The characteristics of 1^+ isobaric configuration energy levels, which may be observed in charge exchange reactions on even-even nuclei, are calculated within the framework of finite Fermi systems. The results may be used in experimental searches for a new class of resonant nuclear states. (J.W.R.)

37542 RESONANCES IN A THREE-NUCLEON SYSTEM AT LOW ENERGIES. Badalyan, A. M. JETP Lett. (USSR) (Engl. Transl.); 15: No. 3, 115-17(5 Feb 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 3, 167-9(5 Feb 1972).

It is shown that resonances in reactions like $\pi^- + {}^3\text{He} \rightarrow \pi^+ + 3\text{n}$ and $\text{p} + {}^3\text{H} \rightarrow \text{n} + (2\text{np})$ may be explained as n–n final state interactions as well as three-nucleon resonances. It is emphasized that more complete experiments than cross section measurements are needed to determine the mechanism of these resonances. (J.W.R.)

37543 INTERFERENCE EFFECTS IN TWO-STEP REACTION PROCESSES. Burke, D. G.; Waddington, J. C. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 7, 700-7(1 Apr 1972).

In reaction studies on even–even target nuclei, a state for which (a) the population by single-step processes is forbidden, (b) the dominant excitation mechanism is by two-step processes, and (c) two competing reaction paths are involved is frequently of interest. A simple expression is given for such cases which offers some insight into the effects of interference between these two paths. A comparison of the predictions of this expression with several types of experiment is presented. In particular, an interpretation is presented for some recent $({}^3\text{He},\alpha)$ reaction results which could not previously be explained. (auth) (Canada)

37544 NEW CALCULATIONAL METHOD OF REDUCED WIDTH. Horiuchi, Hisashi (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 3, 1058-60(Mar 1972).

A method for the calculation of reduced particle-decay widths for light nuclei is formulated. The method is applicable to the molecular orbital models which have been successful for light nuclei. The method may be used for analytical and numerical calculations. (J.W.R.)

37545 GROUND STATE BANDS IN EVEN–EVEN NUCLEI AND SHAPE FLUCTUATION MODEL. Mantri, A. N.; Sood, P. C. (Banaras Hindu Univ., India). Progr. Theor. Phys. (Kyoto); 47: No. 3, 1056-7(Mar 1972).

It is shown that a recently proposed three-parameter shape fluctuation model for ground-state bands in even–even nuclei is similar to an earlier phenomenological model. It is also pointed out that the physical interpretation of the parameters for the shape fluctuation model must be viewed with caution. (J.W.R.)

37546 ROTATIONAL MOTION IN DEFORMED EVEN NUCLEUS AND MAGNETIC OCTUPOLE-MOMENTS AND -TRANSITIONS. Yamamura, Masatoshi; Nishiyama, Seiya (Kyoto Univ. Kochi Univ., Japan). Progr. Theor. Phys. (Kyoto); 47: No. 3, 892-900(Mar 1972).

The results on magnetic octupole-moments and -transitions given in a microscopic theory of nuclear rotational motion, which was recently developed by Gross and the present authors, are compared with those shown by Bohr's rotational model for the case of ground-state rotational band of deformed even nucleus. Through this comparison, it can be concluded that this theory may be successful for the microscopic description of rotational motion. (auth)

37547 PHASE TRANSITION FROM A SUPERFLUID STATE TO A NORMAL STATE IN THE GROUND STATE ROTATIONAL BAND. Sano, Mitsuo; Wakai, Masamiti (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 47: No. 3, 880-91(Mar 1972).

The interaction between pairing and nuclear rotation is investigated. The Coriolis force prevents the formation of coupled pairs. Proton and neutron gaps change with rotation in a different way and become zero at a critical angular momentum, respectively. Two critical angular momenta are then predicted corresponding to the disappearance of the proton and neutron energy gaps. The moment of inertia is very sensitive to the energy gap parameters of protons and neutrons. The critical angular momentum and the moment of inertia are calculated for the rare earth nuclei, and comparison with experimental values is made. (auth)

37548 EXCHANGE PART OF THE SINGLE-PARTICLE SPIN–ORBIT POTENTIAL FOLLOWING FROM THE NUCLEON–NUCLEON SPIN–ORBIT INTERACTION. Penzel, R.; Stocker, W. (Univ., Munich). Z. Naturforsch.; 27a; No. 5, 863-4(May 1972).

The exchange part of the single-particle spin-orbit potential following from a two-body spin-orbit potential is calculated. Scheerbaum's approximation of setting the exchange part equal to the direct part is investigated. (auth)

37549 CIRCULAR POLARIZATION OF GAMMA RAYS AND PARITY NONCONSERVING INTERACTIONS. Dumitrescu, O. (Ruhr-Univ., Bochum, Ger.); Gari, M.; Kuemmel, H.; Zabolitzky, J. G. Contract AT(04-3)-63. Z. Naturforsch.; 27a; No. 5, 733-40(May 1972).

An explicit expression for the circular polarization of gamma rays emitted by odd mass deformed nuclei is given. A semimicroscopic description of the nuclear excited states based on pairing plus quadrupole and octupole model is used. The average field is based on a deformed diffuse edge potential. The short-range correlations are taken into account via the generalized Bethe–Goldstone-equation. (auth)

37550 METHOD OF SOLVING THE PROBLEM OF NUCLEON–PHONON INTERACTION IN NUCLEI. Rajcev, P. P. God. Sofii. Univ., Fiz. Fak.; 62: 49-61(1967-1968). (In Bulgarian).

The presented method of solving the nucleon-phonon interaction problem is a unification of the results obtained previously for the case of more than two quasi-particle levels. The Schroedinger equation is solved here under certain supplementary conditions by using the method of derived functions. It is proved that only whole solutions of the system, satisfied by the operator functions, count in the problem of nucleon-phonon interaction. It is shown that such solutions exist and in two particular cases (strong coupling approximation and simplified model with three quasiparticle levels) they are found exactly. (Abstr. Bulg. Sci. Lit., Math., Phys., Astron., Geophys., Geod.)

37551 USE OF STURMIAN FUNCTIONS IN THE CALCULATIONS OF STRIPPING FORM-FACTORS. Bunakov, V. E. (Leningrad Inst. of Nuclear Physics); Gareev, F. A. Phys. Lett.; 39B: No. 4, 424-6(15 May 1972).

The use of Sturmian functions is suggested for the calculation of the transferred-nucleon form factor. In the framework of configuration mixing this makes it possible to avoid the specific difficulties of the continuum diagonalization. A simple equation, which involves the usual well-depth prescription as a zeroth approximation, is derived for the form factors. (auth)

37552 NEW TREATMENT FOR THE PROJECTION OPERATOR IN NUCLEAR G-MATRIX EQUATION. Tsai, S. F.; Kuo, T. T. S. (State Univ. of New York, Stony Brook). Contract AT(11-1)3001. Phys. Lett.; 39B: No. 4, 427-32(15 May 1972).

A new solution for the nuclear G matrix is derived. In this solution, the projection-operator-dependent part of the G matrix is separated out as an additive term and can be evaluated conveniently without solving any coupled integral equations. The combination of this solution with the momentum-space matrix-inversion method provides a very simple and promising method for the calculation of the nuclear G matrix. (auth)

37553 NEW DERIVATION OF PAIRING AND GENERALIZED PAIRING THEORIES FOR NUCLEI. Ghosh, M. K.; Goswami, A. (Univ. of Oregon, Eugene). Phys. Lett.; 39B: No. 4, 433-5(15 May 1972).

A derivation of the pairing and generalized pairing theories for nuclei is given based on a self-consistent orthonormalization procedure within the context of the equation-of-motion method. (auth)

37554 COMMENT ON THE RATIO OF AVERAGE WIDTH TO AVERAGE SPACING OF NUCLEAR RESONANCES. Feshbach, H. (Massachusetts Inst. of Tech.; Cambridge); Mello, P. A. Contract AT(11-1)3069. Phys. Lett.; 39B: No. 4, 461-5 (15 May 1972).

Approximations previously used to derive a limitation on the ratio of average width to average spacing of nuclear resonances are analyzed. By means of a numerical example it is found that the derivation is correct only in the limit of narrow resonances and that it violates unitarity for large widths. The concept of a "physically reasonable" S matrix is introduced and applied to the example with the aid of an approximate analytic evaluation. (auth)

37555 MONOPOLE CORE POLARIZATION. Zamick, L. (Rutgers–The State Univ., New Brunswick, N. J.). Phys. Lett.; 39B: No. 4, 471-4(15 May 1972).

The coupling of a particle to a monopole vibration enters, at least in part, into several different problems, such as the isotope shift, the particle–particle and particle–hole interactions, and the Nolen–Schiffer anomaly for the mass difference of mirror nuclei. It is noted that the exchange of a monopole phonon between two particles or between a particle and a hole has the phenomenologically undesirable property of shifting the centers of gravity T = 1 and T = 0 multiplets towards each other. With a monopole coupling strength large enough to explain the Nolen–Schiffer anomaly, the effect on the particle–particle and particle–hole spectrum and hence on the parameters in a binding energy formula is appreciable, so that the full discrepancy apparently cannot be explained via a core polarization mechanism. By using a surface-delta interaction the expressions for the coupling between the particle and vibration becomes very simple. (auth)

37556 INFLUENCE OF THE NUCLEAR MEISSNER-EFFECT ON THE GROUND-STATE ROTATIONAL BANDS OF DEFORMED NUCLEI. Birbrair, B. L. (Leningrad Inst. of Nuclear Physics). Phys. Lett.; 39B: No. 4, 489-91(15 May 1972).

The possible regions of singularities in ground-state bands of deformed nuclei, such as those observed in ^{160}Dy and ^{162}Er, are predicted on the basis of the nuclear Meissner effect. The singularities can occur at Z = 66, 68 or N = 90, 112 (110) in rare earth nuclei and $92 \leq Z \leq 96$ or $138 \leq N \leq 144$ in the actinides. (auth)

37557 INFLUENCE OF AXIALLY ASYMMETRIC DISTORTIONS OF FISSION BARRIERS. Goetz, U. (Univ., Basel); Pauli, H. C.; Junker, K. Phys. Lett.; 39B: No. 4, 436-8(15 May 1972).

The influence of axially asymmetric distortions on the inner fission barriers in the actinide and the superheavy region is investigated. The deformation energy is calculated by means of the Strutinsky prescription, applied to the single-particle states in a Saxon–Woods potential. In going from lighter to heavier elements, the barriers are found to be more and more reduced. (auth)

37558 DISPERSION CORRECTIONS TO THE ELECTRON–NUCLEUS SCATTERING. Lin, W.-F. (Stanford Univ., Calif.). Phys. Lett.; 39B: No. 4, 447-9(15 May 1972).

The nonstatic second-order corrections to elastic electron scattering by nuclei were calculated with a model that can reproduce the whole inelastic excitation spectrum. Both the Coulomb and transverse current interaction are included; intermediate states are summed without using closure. The dispersion correction, expressed relative to the first Born result, is dependent on the nuclear Fermi momentum only. Numerical results for ^{40}Ca are presented and shown to be small (about 3%). This finding justifies the present practice of omitting the dispersion effect in analyzing data; however, it should be included when better experimental accuracy can be obtained in the future. (auth)

37559 THREE-BODY BOUND STATES IN AMADO'S MODEL. Stelbovics, A. T.; Dodd, L. R. (Univ. of Adelaide). Phys. Lett.; 39B: No. 4, 450-1(15 May 1972).

The eigenvalue trajectories of the scattering kernel were calculated with Yamaguchi interactions for a system of three identical particles, for both spin-$\frac{1}{2}$ and spin-zero particles. For potential strengths corresponding to large values of the two-body scattering length, several weakly bound, three-body excited states of the type proposed by Efimov [Phys. Lett., 33B, 563 (1970)] were found and their binding energies were calculated. (auth)

37560 PRACTICAL ANGULAR MOMENTUM PROJECTION METHOD IN MULTI-SHELL HARTREE–FOCK CALCULATIONS; ^{22}Na AS AN EXAMPLE. Lee, H. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Cusson, R. Y. Phys. Lett.; 39B: No. 4, 453-6(15 May 1972).

A practical method for projecting good angular momentum from nonaxial deformed HF intrinsic states involving a large number of particles and j shells is described. The ^{22}Na example shows good results for the excitation energies and E2 and M1 matrix elements. (auth)

37561 DWBA MODEL CALCULATION FOR STRIPPING TO UNBOUND STATES. Schwesinger, B.; Stocker, W. (Univ., Munich). Phys. Lett.; 39B: No. 4, 475-7(15 May 1972).

In an application of Berggren's method, the differential and total DWBA cross sections for stripping reactions are obtained in a closed analytical form—available for bound and unbound (Gamow) states—provided that simple optical potentials are involved. (auth)

37562 FOLDING AND DEFORMED POTENTIAL MODELS FOR INELASTIC SCATTERING. Satchler, G. R. (Oak Ridge National Lab., Tenn.). Phys. Lett.; 39B: No. 4, 495-8(15 May 1972).

It is important to include exchange effects when generating transition potentials for inelastic scattering from a folding model. The relation between potential and density deformations is discussed. Transition densities and transition potentials are sensitive to the form of deformation assumed. (auth)

37563 INTERFERENCE NEAR THE COULOMB BARRIER AND COMPLEX INTERACTIONS FOR INELASTIC SCATTERING. Satchler, G. R. (Oak Ridge National Lab., Tenn.). Phys. Lett.; 39B: No. 4, 492-4(15 May 1972).

The interference between nuclear and Coulomb excitation amplitudes for inelastic scattering at energies near the top of the Coulomb barrier is very sensitive to the phase of the nuclear interaction. The ^{114}Cd(^{3}He,^{3}He$'$) reaction is used as an example. (auth)

37564 HIGHER-ORDER CORRECTIONS TO THE OPTICAL POTENTIAL FOR KAONIC ATOMS. Eisenberg, J. M. (Univ. of Virginia, Charlottesville); Guy, Reed. Can. J. Phys.; 50: No. 1, 57-60(1 Jan 1972).

Second-order corrections to the optical potential for kaonic atoms are evaluated in the form of an approximate, local potential which takes into account an isovector correlation function but omits Pauli and hard-core correlations. The corrections are found to be very small, a result not appreciably modified when rough estimates of the consequences of Pauli correlations are considered. (auth) (Canada)

37565 NUCLEON–NUCLEON S-SCATTERING. II. THE NUMERICAL STABILITY TEST. Drumm, H.; Truebenbacher, E. (Univ., Mainz). Z. Naturforsch.; 27a; No. 5, 860-1(May 1972). (In German).

The numerical stability test is discussed which prevented the decision on the usefulness of a non-relativistic nucleon-nucleon potential of a previous paper, and this decision is finally accomplished by fulfilling the stability condition. (auth)

37566 USE OF THE DEUTERON STRIPPING REACTION TO INVESTIGATE INTERMEDIATE STRUCTURE OF NUCLEI. Bremner, William Shields. Athens, Ohio; Ohio University (1971). 119p. University Microfilms Order No. 72-13,677.

Thesis.

Since quasi-bound states have been used to explain intermediate resonances, such states may be useful in explaining the gross features of a more complex reaction. The object of this research is to study one aspect of the deuteron stripping reaction in terms of quasi-bound states. An expression is formulated for the angular distribution of protons from a deuteron stripping reaction which populates quasi-bound states of the neutron-target system. A Faddeev-like method, which illustrates the use of multipliers, is required to avoid the presence of non-compact operators in the three-body formulation. Since stripping to quasi-bound levels is a rather complicated process, it is necessary to simulate the actual stripping reaction with a simple model of the reaction. In the model reaction a beam of unpolarized deuterons impinges upon a spin zero shell model target in its ground state. The proton can excite no internal degrees of freedom of the target. The proton-target interaction can then be simulated by a central local optical potential. The neutron, however, is assumed to interact with the degrees of freedom of the target to form a quasi-bound state of the neutron-target system. Since the quasi-bound state has a finite lifetime, the proton is not expected to be involved in the decay of the quasi-bound state. The proton is assumed to interact with the quasi-bound system so quickly as to leave the reaction before the quasi-bound state decays. A heuristic computer calculation was done to compare the angular distribution of the formulation with experimental work. To infer the utility of the formulation two numerical calculations were actually done. In each reaction a beam of fifteen MeV deuterons was assumed to interact with ^{12}C to form a quasi-bound state of ^{13}C. The first case involved describing the 6.87 MeV level in ^{13}C as a quasi-bound state. In the second case the 9.5 MeV level in ^{13}C was assumed to be a quasi-bound state. Since the 6.87 MeV level in ^{13}C has a spin and parity given by $^5\!/_2{}^+$, it is assumed that the ^{12}C nucleus is excited to a 2^+ state. The 2^+ state is simulated by annihilating a $p^3\!/_2$ neutron and creating a $p^1\!/_2$ neutron. The $p^3\!/_2$ hole is coupled to the $p^1\!/_2$ particle to form the 2^+ state. Either a $2s^1\!/_2$ or a $d^5\!/_2$ neutron is coupled to the 2^+ particle-hole configuration. According to the experimental data a linear combination of the $2s^1\!/_2$ and $d^5\!/_2$ states will describe the angular distribution of the stripping rather well. Since the 9.5 MeV level in ^{13}C has a negative parity and a spin of $^3\!/_2$, an uncoupled particle-hole configuration was formed in ^{12}C. The uncoupled neutron was in a $2s^1\!/_2$ or $d^5\!/_2$ state. The hole-state was a $p^3\!/_2$ state. The uncoupled neutron was then coupled to a new neutron in the same state so that the particle-particle angular momentum is zero. The 9.5 MeV level might also be described as a linear combination of $2s^1\!/_2$ and $d^5\!/_2$ states. (Diss. Abstr. Int., B)

37567 TRINUCLEON BOUND-STATE PROPERTIES FROM AN EXACT SOLUTION OF THE FADDEEV EQUATIONS WITH REALISTIC NUCLEAR FORCES. Harper, E. P.; Kim, Y. E.; Tubis, A. (Purdue Univ., Lafayette, Ind.). Contract AT-4997-54-13965. Phys. Rev. Lett.; 28: No. 23, 1533-6(5 Jun 1972).

The trinucleon bound-state energy, wave function, and charge form factor are calculated from a direct solution of the complete set of Faddeev equations. The nucleon-nucleon interaction (effective in the $^1S_0$ and $^3S_1$–$^3D_1$ states) is given by the Reid soft-core potential. $E_B = 6.7$ MeV, $P(S) = 89.7\%$, $P(S') = 1.7\%$, and $P(D) = 8.6\%$ were found. $|F_{ch}^{^3He}(Q^2)|$ (calculated) is similar to the approximate result of Tjon, Gibson, and O'Connell, and has a minimum at $Q^2 = 15.5$ fm^{-2}. (auth)

37568 GAMMA AND OCTUPOLE VIBRATIONS IN DEFORMED NUCLEI. Immele, J. D. (Univ. of California, Berkeley); Struble, G. L. Nucl. Phys.; A187: No. 3, 459-72(1972).

The gamma (2^+) and octupole (0^-, 2^-) states of deformed even nuclei in the rare-earth region are calculated in the Fermi liquid theory. The relation of RPA and schematic model calculations to the more general formulation is discussed. Off-diagonal matrix elements are found to peak at the nuclear surface. The vibration modes studied are found to be only weakly dependent on the spin- and isospin-dependent terms in the interaction. An example is presented to show the necessity for including a long-ranged term in the renormalized interaction. (auth)

37569 MODEL FOR L-SHELL AUTO-IONIZATION IN β-DECAY. Law, J.; Campbell, J. L. (Univ. of Guelph, Ont.). Nucl. Phys.; A187: No. 3, 525-30(1972).

The previously proposed model for auto-ionization in the K-shell is extended to the L-shell. The comparison between the calculated and available experimental results is not as straightforward as for the K-shell case, due to complications arising from fluorescence yields and Coster–Kronig vacancy shifting probabilities. However, in cases where comparisons are possible the agreements are encouraging. (auth)

37570 INNER-SHELL IONIZATION OF FISSION PRODUCTS DURING NUCLEAR FISSION. Noble, J. V. (Univ. of Virginia, Charlottesville). Nucl. Phys.; A187: No. 3, 568-76(1972).

The time-dependent Schroedinger equation representing the electron cloud of a fissioning nucleus is solved using a variant of the stationary-phase approximation. The problem is unusual in that the time-varying part of the Hamiltonian can never be regarded as a small operator, and so a novel treatment is required. The ionization probabilities per fission for the K- and L-shells of the daughter atoms are calculated and turn out to be substantial (i.e., $P_K + P_L \approx 0.2$). (auth)

37571 RELATIVISTIC CORRECTIONS TO COULOMB ENERGY CALCULATIONS. Chaffin, E. F.; Swamy, N. V. V. J. (Oklahoma State Univ., Stillwater). Nucl. Phys.; A187: No. 3, 593-8(1972).

Coulomb energies of nuclei have been calculated using a recently introduced relativistic nuclear shell model. The results are very close to those of the usual non-relativistic, isotropic harmonic oscillator shell model, showing the most deviation for heavy elements such as lead. (auth)

37572 RELATIONSHIP OF DELAYED NEUTRONS RADIATION AND OF A FISSION PROCESS. Maksyutenko, B. P. Yadern. Fiz.; 15: No. 3, 448-56(Mar 1972). (In Russian).

The relationship of delayed neutron radiation and the fission process was examined. A method has been elaborated on the basis of which the number of prompt fission neutrons and the dispersion of this number have been calculated. This method was shown to apply for the calculation of the same quantities in the fission process induced by the fast neutrons. On the basis of the examination of the fission products charges and of the cumulative yields a connection was considered between the number of radiated prompt fission neutrons and of the fragment mass. The width of the excitation energy distribution in the fission process was found. (auth)

37573 ASYMMETRY OF NUCLEAR FISSION WITH TAKING INTO ACCOUNT THE QUANTUM EFFECTS. Geilikman, B. T.; Zimina, O. V. (Physical-Technical Inst., Moscow). Yadern. Fiz.; 15: No. 3, 457-65(Mar 1972). (In Russian).

The fission process is considered in a model which takes into account the doubling of the surface energy minimum. The quantum dynamics process of the deformation being considered, an asymmetric fission products mass distribution is shown to dominate at any distance between the doubling and fission points. When this distance is small, asymmetric peaks with shallow hollows may be observed. The influence of the quantum dynamical effects on the peak structure is studied. (auth)

37574 LEVELS OF EVEN–EVEN NUCLEI WITH HIGH ANGULAR MOMENTA IN A PHENOMENOLOGICAL COLLECTIVE NUCLEAR MODEL. Budnik, A. P.; Rabotnov, N. S.; Seregin, A. A. Yadern. Fiz.; 15: No. 3, 470-3(Mar 1972). (In Russian).

The energy levels of even–even nuclei with angular momenta up to $J = 12$ were calculated in the frame of a phenomenological collective model with a potential energy dependent on the deformation variables β and γ. The results obtained are compared with experimental data on the nuclei lying in the intermediate region of the deformation variables. (auth)

37575 PARTIAL WIDTHS AND STRONG CHANNEL COUPLING. Grishanova, S. I.; Niledvin, S. D.; Titarenko, N. N.; Yadrovskii, E. L. (Moscow State Univ.). Yadern. Fiz.; 15: No. 3, 474-7(Mar 1972). (In Russian).

The diagonalization method of the shell model is compared with a strong channel coupling method. As examples a calculation of partial neutron decay widths of the quasistationary 0^--state in ^{90}Y and proton decay widths of the quasistationary isobaric-analog 0^+-level of ^{208}Bi nuclei are considered. (auth)

37576 POLARIZATION EFFECTS IN (p,2p) REACTIONS. Kolybasov, V. M.; Smorodinskaya, N. Ya. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 15: No. 3, 483-91(Mar 1972). (In Russian).

Expressions for the recoil nuclei asymmetry and polarization in (p,2p)-reactions were obtained. The reaction amplitude was presented in a form of sum of a pole term and some additional term which approximate the contribution of more complicated diagrams. Two particular cases were examined separately: a) nonsymmetric complanar case; b) a case when only a direction and a momentum magnitude for a recoil nucleus was known. A numeral estimation of polarization and asymmetry for a number of nuclei was given using published information on the real and imaginary parts of the additional term. The results of calculations were compared with experimental data. (auth)

37577 NUCLEAR OPTICAL MODEL. Hodgson, P. E. (Oxford Univ.). Rep. Progr. Phys.; 34: No. 8, 765-819(1971).

The main features of the nuclear optical model are reviewed, with particular attention to current growth points. The determination of the form and strength of the nucleon–nucleus interaction by calculation from the nucleon–nucleon interaction is described and the results compared with those obtained phenomenologically. The potential is applied to analyze single-particle bound states, and it is shown how this can give its isospin and state dependence. Even when it is used simply to calculate the elastic scattering, the optical model must be established in the framework of nuclear reaction theory, and allowance made for the effects of all the reaction channels, and in particular for the compound nucleus processes and the associated fluctuations in the cross sections. The model can then be applied to analyze data on the elastic scattering of nucleons, deuterons, helions, tritons and α particles by nuclei, and this enables its parameters to be determined more precisely and its range of validity to be investigated. The nucleon data is so extensive that it is possible to study several small terms in the potential, in particular the isospin term and the nuclear spin term, in addition to the familiar spin–orbit term. The scattering of the composite particles shows several apparently anomalous features that on investigation yield additional information on nuclear structure. The optical model may be extended to give the inelastic as well as the elastic scattering, and this makes it possible to analyse many apparently complicated phenomena. The application of the results of optical model analyses to the calculation of compound nucleus cross sections is also discussed, together with the use of optical model wavefunctions in calculations of direct reaction cross sections. (auth) (UK)

PHYSICS (PLASMA AND THERMONUCLEAR)

37578 PLASMA PHYSICS INDEX. VOLUME 7, NO. 4, 1972. Bibliography, Author Index, Subject Index. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 151p.

This listing contains 416 articles on various aspects of plasma physics. (M.O.W.)

Confinement and Heating

Refer also to abstracts 37658 and 37700.

37579 (EUR-CEA-FC—601) NEOCLASSICAL THEORY OF MAGNETIC PUMPING IN TOROIDAL GEOMETRY. TABLES OF RESULTS. Canobbio, E.; Giuffre, S. (European Atomic Energy Community. Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec 1971. 34p. Dep. NTIS (U. S. Sales Only).

Detailed results of the neoclassical theory of magnetic pumping with toroidal geometry are presented. The critical density n_C^H separating the nonlinear heating region from the linear region is compared with the critical density n_C^D separating the banana from the plateau region encountered in neoclassical toroidal diffusion. The same variational procedure is used to deduce n_C^H and n_C^D from the full Fokker—Planck equation. (France)

37580 (ORO—4211-4) HIGHER-TEMPERATURE LIMIT FOR TURBULENT HEATING OF PLASMA BY A CROSS-FIELD CURRENT. Hirose, A.; Alexeff, Igor (Tennessee Univ., Knoxville). [nd]. Contract AT(40-1)-4211. 11p. Dep. NTIS.

In theoretical and experimental studies of high frequency ($\omega_{ci} \ll \omega < \omega_{pi}$), ion heating, and electrostatic instabilities driven by a current perpendicular to both a density gradient and an external magnetic field, one instability is found to remain active for a current velocity smaller than the ion thermal velocity. For one experiment, the level of turbulence, effective ion collision frequency, and ion heating rate are also estimated. (auth)

37581 (UCRL—51207) ANOMALOUS RADIAL PLASMA LOSSES IN A Q-MACHINE WITH MIRROR MAGNETIC FIELDS. Searing, Richard Manor (California Univ., Livermore. Lawrence Livermore Lab.). Apr 1972. Contract W-7405-eng-48. 171p. Dep. NTIS.

Thesis.

Observations of a potassium ion plasma in a Q machine with mirror magnetic fields located at the hotplates indicate that a strong localized radial electric field is formed at the hot-plate edge, producing both ion confinement and a rotating high-velocity annulus in the column. The plasma equilibrium formed can be adequately described by an isothermal fluid model that includes ion viscosity and the inertia associated with the column rotation. When the midplane magnetic field B_0 on the axis exceeds 300 G for all measured densities, azimuthally propagating waves are observed which are located at the edge of the rotating annulus. These waves are identified as transverse velocity shear excited modes by comparison of the data with the predictions of the "velocity jet ' model of Perkins and Jassby with regard to frequency, mode localization, and correlations between the perturbed density and potential. The modes contribute little to the radial losses that are due mainly to resistive diffusion. When B_0 is between 150 and 300 G, an azimuthally propagating m = 1 mode appears when both the density and rotation speed exceed lower thresholds. Subsequent mode time growth produces a large plasma loss and self-suppression as the column plasma density is driven below the threshold level. Comparison of the m = 1 mode stability, frequency, and growth rate with the plasma model of Chu, Hendel, and Politzer indicate that the mode is probably an ion diamagnetic drift wave that is driven unstable by a combination of resistive and centrifugal effects. Detailed studies of the nonlinear development of the mode show that the plasma losses are primarily caused by ExB radial convection and are quantitatively consistent with the measured losses from the plasma column. (auth)

37582 EFFECT OF THE DYNAMICS OF A LASER PULSE ON THE HEATING OF CONFINED PLASMAS. Beaudry, G.; Martineau, J. (Univ. of Quebec, Varennes). Can. J. Phys.; 50: No. 6, 594-9(15 Mar 1972). (In French).

The influence of the form of a laser pulse on the heating of a spherically confined (deuterium) plasma was evaluated theoretically, taking into account the mechanisms of inverse electron—ion bremsstrahlung and stimulated Compton scattering. The case of a normal pulse (symmetric in time with respect to the maximum) was compared with that of a modified pulse. Numerical calculations were also made for a more realistic model of an elliptically confined plasma. In both cases the results show a temperature doubling effect under certain conditions. (auth)

37583 MOLECULAR-COHERENCE EFFECT IN PAIR PRODUCTION. Proriol, J.; Roche, G. (Univ., Clermont-Ferrand, France). Lett. Nuovo Cim.; 3: No. 15, 642-4(8 Apr 1972).

A theoretical study was made of the importance of the molecular-coherence effect in pair production. From the Bethe—Heitler equation, an equation is derived for the differential cross section which takes account of the coherence effect. The integrated form factor for the electric charge distribution in the molecule is $|F_m(q)|^2 = 2|F(q)|^2 (1 + \sin qR/qR)$, where F(q) is the atomic form factor. The coherence effect will appear when sin qR/qR is important, i.e., when q is minimum, and $q_{min} \simeq 2/k$. Some values of (1 + sin qR/qR) are tabulated for k = 50.7, 67.6, 101, and 203 MeV for the hydrogen molecule with R = 1.207 Å. It is shown that k and θ must be selected carefully. Another table presents r for $\Phi_+ - \Phi_- = \Pi$, for various θ_{max} values and 203 or 67.6 MeV energies. (D.L.C.)

37584 NEOCLASSICAL DIFFUSION IN AXISYMMETRIC TORUS IN THE INTERMEDIATE REGION. Bhadra, Dilip K.; Liu, Chuan S.; Ohkawa, Tihiro (Gulf General Atomic Co., San Diego, Calif.). Phys. Fluids; 15: No. 7, 1338–41(Jul 1972).

Neoclassical diffusion in the "intermediate" region of a toroidal plasma is studied by means of an asymptotic solution of the Fokker—Planck equation with a small parameter ν_c/ν_t (ν_c, ν_t being the collision and transit frequencies, respectively). The diffusion coefficient is given by $D = D_0[1 + a(\nu_c/\nu_t)^{1/2} - b(\nu_c/\nu_t) \cdots]$ with $D_0 = (\pi/2)^{1/2}(2\pi\rho_e/lR)\ (\rho_e^2\Omega_e)$; a is a small number that vanishes when the radial electric field is neglected; b is a positive quantity of the order of unity. Thus, the diffusion coefficient in the "intermediate" region tends to decrease as collision frequency increases. (auth)

37585 EXPERIMENTAL AND TWO-DIMENSIONAL COMPUTATIONAL STUDY OF END LOSSES FROM A THETA PINCH. Bodin, H. A. B.; McCartan, J.; Pasco, I. K.; Schneider, W. H. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Phys. Fluids; 15: No. 7, 1341-6(Jul 1972).

A theoretical and experimental study of axial plasma flow and end losses in a θ pinch with a collisional 100-eV plasma with β on axis of 0.7 is described. The predictions of a magnetohydrodynamic code two-dimensional in radius and axial length were compared with data from a θ pinch with a coil 8 m long, which gives stable times of some tens of microseconds and good axial resolution. The radial density distribution was measured at four axial positions and its spatial and temporal evolution during the loss process agreed with the computed results. Rarefaction waves were found numerically, and the propagation velocity on a given flux tube agreed with the analytic expression. The computed and measured line density also agreed, and fell sequentially at different axial positions. The results showed that particle flow on a given flux tube depends on the local values of beta and sound speed. Higher-β plasma on the axis is lost more slowly than the plasma as a whole. (auth)

37586 SPECTRAL DEPENDENCE OF DIFFUSION IN A MAGNETIZED PLASMA. Hsuan, Hulbert C. S. (Univ. of Iowa, Iowa City). Phys. Fluids; 15: No. 7, 1300-2(Jul 1972).

The problem of random walk of charged particles across a magnetic field is studied by means of a generalized Langevin formulation. The diffusion coefficient is found to be independent of B, inversely proportional to B, or inversely proportional to B^2, depending upon the electric-field fluctuation spectra. (auth)

37587 EVIDENCE FOR THE HEATING OF A HIGH-DENSITY θ PINCH WHEN TRANSVERSELY IRRADIATED BY A PULSED CO_2 LASER BEAM. Engelhardt, A. G.; Fuchs, V.; Neufeld, C. R.; Richard, C.; Decoste, R. (Institut de Recherche de l'Hydro, Varennes, Quebec). Appl. Phys. Lett.; 20: No. 11, 425-8(1 Jun 1972).

A high-density θ pinch was irradiated by the 0.2-J 180-nsec pulse of a CO_2 laser. Fast photography and spectroscopy monitor the plasma behavior, temperature, and density and permit a comparison with theory. (auth)

37588 AVERAGED EQUATIONS OF LASER HEATING OF TWO-TEMPERATURE PLASMA TAKING INTO CONSIDERATION THE NUCLEAR FUSION HEAT. Kaliski, S. (Inst. of Fundamental Technical Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 2, 113-18(Mar 1972).

The equations are derived for an integral similarity model and for an averaged model of plasmas. The equations should be applied instead of the one-temperature equations of plasma in all cases where $T_i \neq T_e$ is of essential significance. (auth)

Diagnostics

37589 NEUTRAL PRESSURE MEASUREMENTS IN THE VICINITY OF A MAGNETIZED PLASMA. Jacquinot, J.; Deck, C.; Godaert, J. (CEN, Fontenay-aux-Roses, France). Rev. Sci. Instrum.; 43: No. 6, 905-7(Jun 1972).

A fast pressure gage protected against the parasitic effects induced by a magnetized plasma is described. The protection techniques include a modulated electron beam, a secondary electron repeller, and a geometrical shielding of the collector against radiation and fast atoms emitted by the plasma. The apparatus has a rise time of 200 μsec and gives a good signal-to-noise ratio for pressures greater than 10^{-7} torr when it is located near a dense, hot plasma ($n = 10^{13}$ cm^{-3}, $T \simeq 100$ eV). (auth)

37590 DETERMINATION OF THE PLASMA DENSITY IN A COLLISIONLESS PLASMA. Dote, Toshihiko (Inst. of Physical and Chemical Research, Wakoshi, Japan). J. Phys. Soc. Jap.; 32: No. 6, 1619-26(Jun 1972).

In place of Lam's unified probe theory in a collisionless plasma, which is valid in the limit of ξ_e (the ratio of the probe radius to the Debye radius of the plasma) $\rightarrow \infty$, a probe theory for a finite ξ_e is developed. Some diagrams for determination of the plasma density from the positive ion current—voltage characteristics of the probe are also presented. Moreover a few kinds of experiments in a mercury diffusion plasma are carried out in order to verify the theory in rather wider condition and exemplify some applications to the theory in lower-pressure plasma. (auth)

37591 POSSIBILITY OF EVALUATING THE EFFECTIVE ELECTRON TEMPERATURE FROM THE SELF-RADIATION OF A PLASMA IN A PLASMA-BUNCH DISCHARGE. Basharinov, A. E.; Lukinov, I. N. (Moscow Physical-Technical Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 968-70(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 1064-6(Sep-Oct 1971).

A diagram is given of the experimental unit for studying the characteristics of the radiation from a heated magnetized plasma near the harmonics of the electron gyrofrequency. A helium plasma with a pressure of 10^{-2} to 10^{-3} mm Hg and an electron density of 10^{10} to 10^{11} cm^{-3} was created by an electron bunch of 10 to 40 mA and longitudinal energy of 1000 eV. The radiation was measured using a radiometric receiver at a frequency of 8.9 Hz in the 30-MHz band with a sensitivity of 1.5°K sec$^{-½}$. (M.O.W.)

37592 FLOW FIELD DIAGNOSTICS IN RAREFIED SLIGHTLY IONIZED HYPERSONIC FLOW. Avidor, J.; Lederman, S. (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). Israel J. Technol.; 10: No. 1-2, 113-21(1972).

Two independent diagnostic techniques, the electrostatic probe and the electron density probe, were utilized in order to determine the relation between the ionized and neutral specie concentrations in a flow field. The wake of a 10° half angle cone in a hypersonic shock tunnel was utilized for that purpose. The resulting experimental data lead to the conclusions that the ionized specie concentration can only be related to the neutral density concentration in a frozen chemistry flow field and in regions where diffusion is nonexistent or negligible. (auth)

37593 PROBE MEASUREMENTS IN PLANE DOUBLE LAYERS IN LOW-PRESSURE GAS DISCHARGES. von Specht, Hellmut; Herrmann, Diethard (Ernst-Moritz-Arndt-Univ., Greifswald, Ger.). Beitr. Plasmaphys.; 11: No. 4, 317-25 (1971). (In German).

The energy distribution function of the electrons on the anode side of the lattice double layer in gas-filled triodes takes place through the superposition of a fast electron group and an isotropically slow electron group. The slow electrons originate from the fast electrons by inelastic collisions. At high resolution (amplification) of the second derivatives of the probe characteristic lines, two maxima could be found in the high-energy part of the slow electron group. The existence and location of the two maxima are explainable by the energy low of the fast electrons according to the pattern of the total excitation cross section. (tr-auth)

37594 COMPARISON OF LANGMUIR PROBE AND rf CAPACITANCE PROBE ELECTRON DENSITY MEASUREMENTS IN LOW-DENSITY PLASMAS. Smith, Jack (Univ. of Texas, El Paso). J. Appl. Phys.; 43: No. 7, 3031-3(Jul 1972).

Electron densities calculated from data obtained in the laboratory by dc and ac probes simultaneously exposed to low-density low-pressure air plasmas are compared. With electron densities between about 10^{11} and 10^{12} m^{-3} and collision frequencies on the order of 10^8 sec^{-1}, data from a rf capacitance probe operating near 5 MHz and data from the ion saturation region of a dc probe each yield electron density values that generally agree within a factor of 2. By the use of a differential pressure cell, lower electron densities, $\sim 10^9$ m^{-3}, and reduced collision frequencies, $< 10^5$ sec^{-1}, were obtained. Under the latter conditions the dc probe operation was erratic but the ac probe operated satisfactorily, and operated as expected theoretically even under the laboratory limitations. (auth)

37595 ION TEMPERATURE DIAGNOSTIC USING A HIGH-POWER ALTERNATING-CURRENT PROBE. Rubinstein, J.; Laframboise, J. G. (York Univ., Toronto). Phys. Fluids; 15: No. 7, 1259-67(Jul 1972).

A method is presented for using a probe to measure ion temperature in a plasma. The method involves applying a strong rf alternating potential to the probe, of sufficient amplitude to drive electrons away from it via a nonlinear effect which acts preferentially on them. The ion current, essentially unaffected, can then be seen separately and the usual retarding potential technique can be used to measure ion temperature. The method requires electron motion to be sufficiently collisionless. Self-consistent sheath profiles are calculated in order to show that there exists a useful range of driving frequencies and amplitudes over which the dc potential is ion repelling and monotonic and hence the ion current is exponential in probe dc potential. Since the ion and electron fluxes to the probe can simultaneously be made very small, the technique should permit measurements in some environments which would otherwise overheat and destroy probes. An ion heating mechanism based on the electron repulsion effect is also proposed. (auth)

37596 MICROWAVE RESONANCE SHIFT METHOD IN STELLARATOR PLASMA DENSITY MEASUREMENTS. Coulbourn, D. W.; Sesnic, S. S. (Univ. of Texas, Austin). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 357-64(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The resonance-frequency-shift method pertaining to a cylindrical resonator is reviewed, and the theory applicable to the toroidal geometry is discussed. The resonant mode structure in a toroidal resonator is described. It is shown in numerical examples that the presence of plasma will cause a considerable shift in the resonant frequency of the cavity. This frequency shift is directly proportional to plasma density and is also influenced by the magnetic field. The system was built and is described in some detail. A fundamental transistor oscillator, which can be swept over a 0- to 300-MHz bandwidth in the range of 2 to 4 GHz, provides the microwave signal. An oscilloscope provides a sweep voltage which is conditioned to control the oscillator frequency. A staircase voltage is generated which is used along with the horizontal sweep to form a raster of 1 to 64 lines on the oscilloscope. The detected microwave signal is added to the staircase voltage to give the desired display. In this way a time profile of the density can be obtained with as many as 64 points in time. Plasma containment time can be measured by this method. Preliminary results consisting of simulation measurements are described. (auth)

37597 FAR-INFRARED SPECTROSCOPIC SYSTEM USED IN FUSION-PLASMA DIAGNOSTICS. Sesnic, S. S. (Univ. of Texas, Austin). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 365-75(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A far-infrared spectroscopic system, covering the wavelength region between 50 and 100 μm, and capable of variable spectral resolution between 100 and 1000, was built. The spectroscopic system is described in some detail. It is comprised of a monochromator, which utilizes five different echelette gratings, each of which covers one octave, of a radiometric system for absolute power calibration, and of various cryogenic- and room-temperature detectors. The system works in two modes: a continuous mode using the absolute power calibration, the radiometer, and continuous standard radiation sources, and a pulsed mode without the radiometer for plasma radiation studies. In this manner the power spectrum of the observed pulsed plasma radiation is absolutely calibrated. A rather new method in monochromator design utilizing the ray-transfer-matrix method and phase-space diagrams is discussed, and various optical errors in the system are evaluated. The method of performing and the evaluation of radiation studies utilizing this system is presented. Synchrotron radiation from tokamak as a function of the electron temperature and density is discussed. The merits of this diagnostic method for high-temperature, high-magnetic-field plasma investigations are evaluated. This technique is especially appropriate in studies of electron temperature and density as a function of time. Due to the rather fast response time of cryogenic detectors (typically less than one microsecond), collective effects such as turbulence and plasma instabilities can be studied. (auth)

37598 OPTICAL DIAGNOSTICS OF HOT DENSE PLASMAS. Yevick, George; Harvey, Robin; Carr, Wayne (Stevens Inst. of Tech., Hoboken, N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 381-4(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The use of laser light as a monitor for the state of a hot dense plasma is one of the most important and reliable plasma diagnostic techniques. Problems encountered in Thomson scattering, electron temperature measurements, and interferometric density measurements are discussed. Finally, the possibility of two-wavelength scattering, yielding a deep insight into the phase space distribution of a plasma is presented. (auth)

37599 PLASMA DIAGNOSTICS OF A PULSED DISCHARGE IN A PLASMA. I. Borodin, V. S.; Gebekov, V. D.; Kagan, Yu. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 31: No. 4, 280-1(Oct 1971).

Translated from Opt. Spektrosk.; 31: No. 4, 525-8(Oct 1971).

A method is proposed for determining the maximum value of the electron concentration from the time-integrated profile of the hydrogen line in a pulsed discharge. Under the assumption of thermodynamic equilibrium, an equation was obtained that relates the half-width of the time-integrated profile to the maximum value of the concentration. (auth)

37600 CONTACTLESS METHOD FOR TRANSMITTING SIGNALS UNDER CONDITIONS OF STRONG EXTERNAL INTERFERENCES. Pil'skii, V. I.; Serdyuk Yu. N. (Nuclear Physics Inst., Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 14: No. 4, 1099-1100(Jul-Aug 1971).

Translated from Prib. Tekh. Eksp.; 14: No. 4, 130-1(Jul-Aug 1971).

A method is described for transmitting a signal from a pickup to an oscilloscope through a dielectric waveguide at frequencies in the centimeter and millimeter microwave ranges. Devices based on this principle were used in investigating fast processes in plasma. (auth)

37601 MEASUREMENT OF ELECTRON DENSITY GRADIENTS USING A MODIFIED JAMIN INTERFEROMETER. Woolsey, G. A.; Illingworth, R. (Univ. of Strathclyde, Glasgow). J. Phys., E (London); 5: No. 6, 575-8(Jun 1972).

The use of a modified Jamin interferometer for the measurement of electron density gradients in a transient plasma was demonstrated using a small Z-pinch argon discharge. The interferometer was operated with 632.8 nm radiation from a He—Ne laser, and an interference pattern was produced using wedge shaped plates. With both beams of the interferometer passing along the length of the plasma and separated by 3.8 mm, differences in electron density were measured, and hence radial electron density gradients were derived. Electron density gradients as small as 5×10^{22} m^{-4} could be detected with good reproducibility. The Jamin interferometer used in this way was found to have several practical advantages over the Michelson and Mach—Zehnder interferometers, even for absolute electron density measurement. These advantages include simple alignment, fewer optical components, and a stable, easily viewed interference pattern even in the presence of mechanical vibration. The interferometer was also used to locate the position of the center of the Z pinch discharge to within 0.2 mm. (UK)

37602 ABSORPTION METHOD FOR MEASURING THE ABSOLUTE CONCENTRATION OF METASTABLE HELIUM ATOMS IN A PLASMA. Fugol, I. Ya.; Myshkis, D. A.; Grigorashchenko, O. N. Opt. Spectrosc. (USSR) (Engl. Transl.); 31: No. 4, 282-[illegible](Oct 1971).

Translated from Opt. Spektrosk.; 31: No. 4, 529-35(Oct 1971).

Integral absorption of the resonance line for an external source and self-absorption of the 388.9-nm and 501.6-nm helium lines are calculated for temperatures of 4 to 300 K and pressures of to 70 mm. The calculations were carried out for the Voigt prole, with the multiplet line structure taken into account. In the general form, the asymptotic behavior is analyzed for the limiting cases of low and high optical densities. The nonmonotonic behavior of self-absorption at large optical thicknesses is investigated and analyzed. These calculations make it possible to determine the absolute concentration of helium atoms in the 2^3S and 2^1S states. (auth)

37603 DUAL MAGNETIC PROBE SYSTEM FOR THE PHASE MEASUREMENTS IN THERMAL INDUCTION PLASMAS. Eckert, H. U. (Aerospace Corp., El Segundo, Calif.). J. Appl. Phys.; 43: No. 6, 2707-13(Jun 1972).

Previously reported measurements of rf magnetic field distributions in thermal induction plasmas by a water-cooled coil probe were extended to phase measurements through the use of a second identical probe placed at a fixed position near the plasma boundary. From measurements of the vector sum and/or difference in addition to the individual signals from both probes, data for the variation of the phase angle with radius were obtained. The reliability of the method was checked with an electrolyte of known conductivity. Tests conducted at 2.6 MHz in a 14-cm-wide argon-plasma column at ambient pressure yielded a change in phase angle of 285° over the radius. The variations in phase and magnitude of the magnetic field were used to derive those of the induced electric field, the current density, the electrical conductivity, and the real part of the Poynting vector. From the latter, a specific power input of about 1500 W/cm was obtained. A correlation of the conductivity data with temperatures derived from absolute line and continuum intensities is in good agreement with predictions from an equilibrium theory. (auth)

37604 DIELECTRIC RELAXATION IN INSULATING LAYERS ON CONTAMINATED LANGMUIR PROBES. Olson, Robert A. (Systems Research Labs., Inc., Dayton, Ohio). J. Appl. Phys.; 43: No. 6, 2785-9(Jun 1972).

Measurements were made of the low-frequency admittance of contaminated Langmuir probes in a mercury-vapor plasma. It was found that the probe admittance components were frequency dependent and could be represented by an equivalent electrical circuit corresponding to a metal—insulator—plasma configuration. The frequency dispersion of the admittance components is described by the empirical equation $Y = G_\infty - (G_\infty - G_0)/[1 + (G_0/G_\infty)(j\omega\tau_0)^{1-h}]$, where Y is the complex admittance, G_0 and G_∞ are the static and infinite-frequency values of conductance, τ_0 is a relaxation time constant, and h is a parameter with values between 0 and 1. The complex-plane locus of the admittance is a circular arc from which the resistance of the insulating layer on the probe surface, the plasma-sheath resistance, and the value of h are derived. The susceptance—voltage characteristic of a probe is shown to be a sensitive indicator for the presence of insulating material on the probe surface. The susceptance—voltage curve for an insulator-contaminated probe has a peak in the vicinity of plasma potential which disappears upon removal of the insulating material by sputtering. (auth)

37605 AUTOMATIC PLOTTING OF LANGMUIR-PROBE SUSCEPTANCE- AND CONDUCTANCE-VOLTAGE CURVES. Olson, Robert A.; Nordlund, D. R. (Systems Research Labs., Inc., Dayton, Ohio). J. Appl. Phys.; 43: No. 6, 2780-5(Jun 1972).

Langmuir-probe susceptance— and conductance—voltage measurements were made using a system which automatically plots the in-phase and quadrature components (simultaneously) of a two-terminal complex admittance, as a function of applied dc potential. The operation of the system, which utilizes phase-sensitive detection to separate the admittance components, is discussed. Measurements for a planar guardsleeve probe in a mercury-vapor plasma (collisionless) and for a spherical probe in an argon plasma (collisional) are presented. Positive and negative peaks observed in the low-frequency susceptance—voltage characteristic are discussed in terms of ion-response, probe-contamination, and plasma-perturbation effects. (auth)

37606 INVESTIGATION OF AN rf PLASMA WITH SYMMETRICAL AND ASYMMETRICAL ELECTROSTATIC PROBES. Gagne, R. R. J. (Laval Univ., Quebec); Cantin, A. J. Appl. Phys.; 43: No. 6, 2639-47(Jun 1972).

A capacity coupled plasma facility and the techniques implemented to solve problems associated with the use of electrostatic probes in rf discharges are described. Supporting experimental results are also presented. A new technique devised to minimize the rf voltage at the plasma—probe junction is explained, and a floating optically coupled capacitive probe arrangement, for accurate measurement of this voltage, is discussed. Description is made of a feedback network which is used to stabilize rf potentials and plasma parameters over periods of several hours. The calibration of a focused X-band microwave interferometer indicates that the presence of the Pyrex plasma container has no noticeable effect on the electron density deduced from phase-shift measurements. At a pressure of 0.7 torr in argon, space-resolved electron temperatures, deduced from symmetric and asymmetric double-probe I—V characteristics, indicate that the electron temperature is radially constant in the plasma column, and has a value which is 25% higher than that predicted by using the von Engel and Steenbeck theory for a similar positive column.

The radially integrated charge density profile, deduced from the probe ion current using the collisionless Laframboise theory, agrees within 15% with that estimated from measurements made with a microwave interferometer. Collision-dominated probe theories are also considered and found to be less applicable. (auth)

Kinetics (General)

37607 (ORNL-TM-3700) HOLDUP EXPERIMENTS EMPLOYING ARGON-HELIUM MIXTURES IN COAXIAL MAGNETOPLASMADYNAMIC FLOW. Keyes, J. J. Jr. (Oak Ridge National Lab., Tenn.). Jun 1972. Contract W-7405-eng-26. 47p. Dep. NTIS.

A technique is described and evaluated for determining, in a relatively direct manner, the influence of an axial magnetic field on holdup of argon in a coaxially fed argon-helium plasma generated by a radio-frequency induction. This is a transient technique in which the gas whose composition is to be determined is isolated in the plasma chamber and the final mixture analyzed after the plasma has been extinguished. Detailed statistical analysis of the results has led to the conclusion that the variables which significantly influence the argon holdup are the magnetic flux density, helium/argon inlet velocity ratio, argon inlet Reynolds modulus, and the plasma exit temperature. The data are correlated in terms of functions of the above four variables using three parameters whose optimum values are determined by a nonlinear regression analysis. It is concluded that the fractional increase in argon concentration (holdup) in the plasma chamber effected by application of the magnetic field increases with the magnitude of the field at values of an argon Reynolds modulus-helium/argon velocity ratio dependent function exceeding a critical value. (auth)

37608 (ORO-4211-5) SPARK BREAKDOWN: AN ELECTROSTATIC CRITERION. Alexeff, Igor (Tennessee Univ., Knoxville. Dept. of Electrical Engineering). [nd]. Contract AT(40-1)-4211. 14p. (CONF-720401-5). Dep. NTIS.

From Region III conference on scanning the spectrum; Knoxville, Tenn. (10 Apr 1972).

One basic process causing the dc high-voltage breakdown of a gas is examined. A modified criterion for the transition of a Townsend avalanche to a streamer discharge is discussed. Instead of the assumption that the electrons in the avalanche are spread laterally by multiple scattering on gas molecules (thermal diffusion), the assumption used is that the electrons are spread solely by mutual electrostatic repulsion. A criterion is found that yields quantitative results comparable to those obtained using the "multiple scattering" assumption. This modified criterion is probably most useful where "multiple scattering" is improbable—where an electron loses almost all of its energy on colliding with complex gas molecules. (auth)

37609 PRESSURE BROADENING OF MULTIPLY IONIZED CARBON LINES. Bogen, P. (European Space Research Inst., Frascati, Italy). Z. Naturforsch.; 27a: No. 2, 210-14(Feb 1972).

In a helium plasma with carbon impurity, the pressure broadened profiles of seven C III and two C IV lines were measured. The plasma produced by magnetic compression had typically an electron density of 4×10^{17} cm^{-3}, a temperature of 60,000°K, and a lifetime of about 0.1 μs. Electron densities were deduced from the width of the He II $\lambda = 3203$ Å line. If $\Delta E_{ii'} \ll kT$ ($\Delta E_{ii'}$ = energy difference between perturbed level i and perturbing level i′) the classical straight line nonadiabatic theory gives values being in good agreement (error $< \pm 25\%$) with measured widths for six lines. For two lines, the deviations are larger. For the C IV resonance line ($\lambda = 1550$ Å) with $\Delta E_{ii'} > kT$, the profile can be explained by hyperbolic path, adiabatic collision theory. The semiempirical Gaunt-factor approximation gives a rough estimate of the width, but normally the values obtained are too low. (auth)

37610 TRANSIENT BEHAVIOR OF COLLISIONAL-RADIATIVE RECOMBINATION IN ATOMIC HELIUM PLASMAS. Limbaugh, Charles Cameron. Knoxville, Tenn.; Univ. of Tennessee (1971). 221p. University Microfilms Order No. 72-15,535. Thesis.

The set of detailed rate equations describing the transient decay of singly ionized, constant temperature, constant pressure, monatomic helium plasmas is solved numerically for early times in the plasma decay. These equations, called the eigenstate rate equations (ERE), have been studied previously for late times in the decay through application of the quasi-steady-state (QSS) assumption and resulted in the collisional-radiative recombination (CRR) model for description of the electron density decay rate in plasmas. The application of the QSS to the ERE makes it impossible to study the mechanisms and the transient coupling by which the final distributions are established. The QSS assumption is specifically removed in this study so that the ERE can be solved completely for the early transient characteristics of the plasma decay. In this way the validity of CRR theory can be assessed and the important mechanisms in the early plasma decay can be illustrated as well. In the range of conditions studied ($6{,}000°K \le T_e \le 14{,}000°K$, 2.69×10^{11} 1/cm$^3 \le n_e \le 1.63 \times 10^{15}$ 1/cm^3, 5.0×10^{13} 1/cm$^3 \le n_0 \le 1.63 \times 10^{17}$ 1/cm^3) it is found that CRR can be applied to the electron density decay before the atomic eigenstates in the plasma reach the QSS. Times for the QSS to be established ranged from 3×10^{-9} sec for the high density plasmas to 7×10^{-4} sec for the low-density plasmas. It is found that in a plasma decay the ground-state rate and the free-electron decay rate can overshoot the QSS condition before returning to it. This is due to the transient coupling between the 2^3S state and adjacent states and is a transient phenomenon that requires the ERE for elucidation. It is also found that when the plasma is subjected to a decaying electron temperature the plasma may never achieve the QSS. In this situation the QSS will continually lag behind the temperature decay. (Diss. Abstr. Int., B)

37611 THERMODYNAMIC PROPERTIES OF A CESIUM PLASMA. Fortov, V. E.; Lomakin, B. N.; Krasnikov, Yu. G. (Moscow Physical-Technical Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 789-97(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 869-78(Sep-Oct 1971).

The thermodynamic functions of a cesium plasma are calculated on an electronic digital computer for p = 5, 50, 150 atm and T = 3 to 15×10^3°K. Various approximations are used to consider the contribution of bound states and the influence of Coulomb interaction of the continuum particles on the thermodynamic functions. A large contribution of bound states was noted in the considered range of parameters, which in a number of cases exceeded the contribution from the interaction of continuum particles. (auth)

37612 TRANSFER OF HEAT BETWEEN ELECTRODES AND THE LAMINAR FLOW OF AN ARGON-POTASSIUM PLASMA. Petukhov, B. S.; Ivanov, E. F.; Zhilin, V. G. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 897-901(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 986-90(Sep-Oct 1971).

Experimental data are given for heat flows to electrodes from an argon-potassium plasma. The data were derived for a current-density range from ~0.1 to 10 A/cm^2 under conditions of a distributed discharge. The energy balance at the anode and at the cathode is evaluated. The effect of the heat evolved near the electrodes, on the transfer of heat to the electrodes is studied. (auth)

37613 INVESTIGATION OF THE ELECTRICAL CONDUCTIVITY OF A WEAKLY NONIDEAL PLASMA IN A SHOCK TUBE. Son, E. E.; Pavlov, G. A. (Moscow Physical-Technical Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 965-7(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 1062-4(Sep-Oct 1971).

The effects of electron-atom scattering on conductivity is investigated along with the effect of nonideality on the conductivity of a Coulomb gas. The variational method was used for solution of the kinetic equation of a model of a three-component plasma. The calculations show that experiments must be carried out at higher temperatures where the Coulomb contribution is greater. (M.O.W.)

37614 DETERMINATION OF A PLASMA EMITTER FORM IN AN ACCELERATING ELECTRIC FIELD. Volkov, B. I.; Sveshnikov, A. G.; Semashko, N. N. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 201: No. 4, 806-8(1 Dec 1971). (In Russian).

A source of charged particles, in which a plasma boundary serves as emitter, is studied. Between the plasma boundary and the external conductors there is established a flow of charged particles that screens the electric field. A corresponding mathematical problem is formulated and a solution is offered. (K.S.W.)

37615 RELATIVISTIC ELECTRON BEAM PROPAGATION IN HIGH-PRESSURE GASES. Miller, P. A.; Gerardo, J. B. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 7, 3008-13(Jul 1972).

Experimental results are reported for the transport characteristics of relativistic electron beams in high-pressure atomic and molecular gases. Experimental results obtained with two different accelerators ($\nu/\gamma \sim 0.05$ and 1) are reported. It was found that the highest pressure at which efficient transport occurred was determined by two different physical processes for the two different intensity electron beams. The lower-intensity beam propagated efficiently throughout a large pressure range, and was attenuated at high pressure by Coulomb scattering of the beam electrons in the screened Coulomb field of the nuclei of the background gas atoms. The more intense electron beam was attenuated at a gas pressure which varied with different gases approximately inversely with the high-energy ionization cross section. A radial breakdown mechanism is proposed which may explain the loss process of the intense electron beam. (auth)

37616 RELATIVISTIC ELECTRON BEAM PROPAGATION IN LOW-PRESSURE GASES. Miller, P. A.; Gerardo, J. B.; Poukey, J. W. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 7, 3001-7(Jul 1972).

Studies of the propagation of pulsed relativistic electron beams through initially un-ionized background gases are reported. At very low pressures, pronounced beam front erosion occurs owing to the slow buildup of radial force neutralization of the beam electrons. Numerical simulation and an approximate analytical model are used to describe this beam-loss process. The results of experiments with two different electron accelerators ($\nu/\gamma \sim 0.05$ and 1) are shown to be in good quantitative agreement with the mathematical descriptions over the pressure range of $\sim 1\ \mu$ to ~ 1 torr in a large variety of gases. Propagation characteristics are found to scale in pressure from gas to gas inversely with the high-energy ionization cross sections of the gases. The study shows that direct ionization alone is sufficient to explain the experimental results. The theoretical calculations indicate that the low-pressure propagation characteristics of the lower ν/γ beam are sensitive indicators of the beam's transverse energy. The calculations also indicate that this is not the case for the higher ν/γ beam. (auth)

37617 PLASMA DIAGNOSTICS AND ENERGY TRANSPORT OF A dc DISCHARGE USED FOR SPUTTERING. Ball, C. J. (Bell Telephone Labs., Allentown, Pa.). J. Appl. Phys.; 43: No. 7, 3047-57(Jul 1972).

An investigation of plasma properties and energy-transport mechanisms within a dc anomalous glow discharge was conducted, with particular reference to those processes operating in the vicinity of the anode. The objective of this work was to obtain more quantitative information about the species in the plasma contributing to the heating of substrates located on the anode during sputtering. Techniques employed in this study involved the use of Langmuir probes for the detection of low-energy species, of an electrostatic analyzer for detection of high-energy species within the plasma, and of temperature-sensitive probes for energy-flux measurements. The negative glow of the plasma was found to contain two electron-energy distributions, one of density $\sim 2 \times 10^{10}$ cm^{-3} and mean energy ~ 0.6 eV, and the other $\sim 2 \times 10^{8}$ cm^{-3} and ~ 6 eV energy. A low-energy positive-ion population approximately balanced these densities. Under all operating conditions, the plasma potential was found to be a few volts positive with respect to ground. Energy-flux measurements at the anode showed that the main source of energy was not from these populations in the plasma, however. Further examination of the discharge, using the electrostatic analyzer, revealed the presence of high-energy secondary electrons emitted at, or in, the vicinity of the cathode. Many of these electrons penetrated to the anode with the full fall of cathode potential, and it was found that they were the cause of the initial rapid rise of substrate temperature on commencement of sputtering. Radiation for uncooled cathodes was also a source of energy at the anode, once equilibrium temperatures had been approached. (auth)

37618 VERIFICATION OF THEORY FOR PLASMA OF FINITE-SIZE PARTICLES. Okuda, Hideo (Univ. of California, Berkeley). Phys. Fluids; 15: No. 7, 1268-74(Jul 1972).

Some of the equilibrium properties of a one-dimensional plasma model for numerical simulation using finite-size particles (clouds) with spatial grids were investigated experimentally and compared with the theoretical predictions. Fluctuation spectrum of the electric field, correlation function, and Landau damping of the Fourier modes, drag on a particle, diffusion in velocity space, Debye shielding, wakes due to fast particles, and the frequency spectrum of the Fourier modes were measured. The experimental results give good agreement with the theoretical predictions of a kinetic theory for finite-size particles, showing the reduction of interactions at short wavelengths and, hence, reduction of collisional effects. (auth)

37619 INITIAL-BOUNDARY-VALUE PROBLEM OF FORMATION OF AN ELECTRICAL DISCHARGE IN A FLOW. Wilhelm, H. E.; Liron, N. (Colorado State Univ., Fort Collins). Phys. Fluids; 15: No. 7, 1328-37(Jul 1972).

The initial-boundary-value problem describing the relaxation of a quasi-neutral discharge in a gas flow with coplanar, heated electrodes of finite extension is formulated in the diffusion approximation. The relaxation occurs from an initial breakdown to a steady-state discharge in a weak electric field. The initial-boundary-value problem is decomposed into a steady-state elliptic problem, considering the different boundary conditions at the walls and electrodes and a parabolic initial-boundary-value problem with vanishing boundary conditions. By means of the Fourier-integral and Green's function methods, an analytical solution is obtained for the steady-state and time-dependent electron-ion density fields. The characteristic time describing the relaxation of the discharge is derived. The criterion for the existence and sustainment of a steady-state discharge against plasma losses by diffusion and convection is discussed. (auth)

37620 DEVICE FOR OBTAINING A CONFINED PLASMA INSIDE A CAVITY. Ceccaldi, Maurice; Goujon, Paul; Leicknam, J. P. (to Commissariat a l'Energie Atomique). French Patent 2,082,065. 15 Nov 1971. Filed 2 Mar 1970. (In French).

A device is presented which enables a large confined plasma to be obtained. This plasma can be used as a luminous source, observable from several directions. The device consists of a block of metal acting as a cathode and having a smooth walled groove forming the plasma cavity, an anode, and a means of maintaining a potential difference between the anode and the block. The block and anode are situated in a sealed enclosure containing a gas at reduced pressure. The depth of the groove is greater than its width. (France)

37621 FREQUENCY ANALYSIS OF NON-STATIONARY FLUCTUATIONS. Jancarik, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Int. J. Electron.; 32: No. 6, 665-71(Jun 1972).

A numerical method is described which is capable of analysing a nonstationary fluctuation signal into pre-determined frequency bands. The method consists basically of passing the digitized information through the mathematical analogue of a simple resonant LCR filter, the spurious transient response being removed by a kind of iterative process involving the reversal of the time sequence. Some examples based on observation of unstable collisionless plasma are given. (auth)

37622 INVESTIGATION OF THE RELATION BETWEEN COMPRESSION, RELAXATION, AND END LOSSES IN THE LATE PHASES OF THETA-PINCH DISCHARGES BY MEANS OF A TWO-DIMENSIONAL MHD COMPUTER PROGRAMME. Schneider, Wolfgang (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Phys.; 252: No. 2, 147-61(1972).

A two-dimensional MHD model was developed for the phases after the fast oscillations of theta pinch discharges. This model was tested by comparison with theoretical results and experimental measurements; it turned out that the model aptly describes the quasistationary phases of theta pinches. It is found that the plasma in the late phases is only adiabatically heated. The relaxation of temperature and anisotropy is discussed, particular attention being paid to interaction with heavy impurity ions and to determining the temperature of these ions from Doppler profiles of spectral lines. Finally, on the one hand, the dominant contribution of convection to the end losses is demonstrated by means of a detailed energy balance; on the other, the relevance of thermal conduction to the axial dynamics inside the coil is explained. (auth)

37623 STEADY-STATE THEORY OF A DISCHARGE COLUMN IN A MAGNETIC FIELD: SEPARABLE SOLUTIONS FOR A FINITE CYLINDER. Ilic, D. B.; Self, S. A. (Stanford Univ., Calif.). J. Appl. Phys.; 43: No. 6, 2620-3(Jun 1972).

The problem of the steady state of a magnetized discharge of the positive-column type, in the case of a finite cylinder, is shown to have separable solutions for the radial and axial dependence of plasma density, potential, and electron and ion velocities. Consequently, the results of the corresponding one-dimensional theory may be directly applied to the two-dimensional case. In particular, the theory is applicable to the case of a low-pressure discharge in a strong magnetic field, where the radial flow is collision dominated but the axial motion is collisionless. (auth)

37624 ENERGY DISTRIBUTIONS OF IONS FROM THE ANODE PLASMA OF A PULSED VACUUM ARC. Grissom, J. T.; McClure, G. W. (Sandia Labs., Albuquerque, N. Mex.). J. Mass Spectrom. Ion Phys.; 9: No. 1, 81-93(Jun 1972).

Energy distributions of ions emitted from pulsed vacuum arcs of 5 to 6 μsec duration were measured, using a cylindrical electrostatic analyzer. The arc characteristics include initiation rise times of less than 1 μsec, a total arc potential after initiation of approximately 50 V, and arc currents of approximately 60 A. The ion beam was not mass analyzed. The energy distributions consisted of a single, broad peak with a low-energy cutoff and a high-energy component that extended well beyond the total arc voltage during the period of the discharge when the ions were formed. (auth)

Kinetics (Experimental)

37625 (EUR-CEA-FC-629) X-RAY SPECTROMETRY IN THE 5 TO 20A RANGE. APPLICATION TO THE EXPERIMENT ON MULTICHARGED IONS. Jacquot, C. (European Atomic Energy Community. Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1972. 34p. (In French). Dep. NTIS (U. S. Sales Only).

In order to study the presence of multicharged ions in an ecr plasma, their contribution to different radiation mechanisms in the spectral range 50 to 20A was evaluated. The efficiencies of different soft-x-ray detectors, i.e., semiconductor spectrometers, crystal spectrometers, and grating spectrometers, were compared. (France)

37626 EXPERIMENTAL INVESTIGATION OF THE ELECTRICAL CONDUCTIVITY OF THE PLASMA IN AN ARGON DISCHARGE USING THE AVERAGE-GRADIENT AND TUNED-CIRCUIT-Q METHODS. Molotkov, V. I.; Poberezhskii, L. P. (Moscow Power Inst. Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 798-801(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 879-83(Sep-Oct 1971).

An experimental comparison was carried out of measurements of the electrical conductivity of a plasma in argon by the average-gradient and tuned-circuit-Q methods. It was revealed that for $p\sigma_0 < 200$ torr/Ω·m the tuned-circuit-Q method provides greatly overestimated values of the electrical conductivity, while for $p\sigma > 200$ torr/Ω·m it is in good agreement with the results of measurements carried out by other methods. The calculation of the electrical conductivity according to the method proposed by E. I. Asinovskii and V. M. Batenin using the results of probe measurements yields satisfactory agreement with the results of two other methods. (auth)

37627 DEPENDENCE OF THE PARAMETERS OF A HIGH-CURRENT PULSED DISCHARGE ON THE CURRENT AND INITIAL PRESSURE. Malkin, O. A.; Pyshnov, A. V. (Moscow Engineering-Physics Inst.). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 802-7(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 884-9(Sep-Oct 1971).

A study was made of a pulsed discharge in nitrogen at initial pressures of 0.1 to 50 mm Hg and current densities from 1 to 5 to 6 kA/cm^2. The duration of the quasisteady-state of the discharge was determined in quartz tubes with diameters of 19 and 30 mm, as a function of the initial pressure and of the amplitude of a rectangular current pulse, which reached 40 kA. The concentration of the electrons was measured and was found equal to (0.1 to 9) × 10^{17} cm^{-3}. The electrical conductivity was used to evaluate the temperature of the plasma for an initial pressure of 1 mm Hg; from the evaluation, the maximal value of this temperature was 56,000°K. The power supplied to unit volume of the plasma discharge was varied from 7 to 230 kW/cm^3. (auth)

37628 PLASMA TEMPERATURE DURING THE INITIAL STAGE OF A PULSED XENON DISCHARGE. Vasil'eva, A. N.; Grishina, I. A.; Pis'mennyi, V. D. (Moscow State Univ.). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 785-8(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 865-8(Sep-Oct 1971).

The development of a discharge in xenon at a pressure of 300 mm Hg was investigated. It was shown that during the stage of expansion of the channel, the electron temperature T_e remained constant during several tens of microseconds, while its magnitude depended on the specific features of the initial stage of the discharge. In the quasi-steady stage of the discharge T_e was determined from the recombination continuum, and the value of T_e was calculated during the expansion stage using the value of T_e during the quasi-steady stage. (auth)

37629 ENERGY BALANCE OF IONS IN TURBULENT DISCHARGES IN A LONGITUDINAL MAGNETIC FIELD. Dubovoi, L. V.; Fedyakov, V. P.; Komin, A. V. (Research Inst. of Electrophysical Instruments, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1335-44(Apr 1972). (In Russian).

The efficiency of ion heating in turbulent z discharges with anomalous conductivity due to the excitation of ion-sound instability in the plasma is investigated experimentally. Approximate formulas are derived for calculation of the electron and ion temperature in the current peak of pulsed z discharges in experiments on turbulent plasma heating. The results of the calculations are compared with the experimental data. Satisfactory agreement between the calculated ion temperatures and those measured experimentally is obtained. (auth)

Kinetics (Theoretical)

Refer also to abstracts 36790, 36791, and 37801.

37630 (AEC-WO-477) EXACT ANALYSIS ON A LIMITED PLANE PLASMA IN A MAGNETIC FIELD. Interim Report. Tonks, Lewi. [nd]. 17p. Dep. NTIS.

Declassified 27 Oct 1971.

Some analyses of a plasma in a magnetic field are limited to cases in which the relative change in field over the orbital distance and the relative change in ion concentration are both small, or in which the relations are viewed in a purely hydrodynamical way. The first approach excludes the plasma edge, while the second loses sight of the structure imposed by the orbital motions. This analysis attempts to overcome these limitations. (auth)

37631 (LA-4930) ELECTRON TEMPERATURES AND THERMAL CONDUCTION IN HIGH-ENERGY θ PINCHES. Morse, Richard L. (Los Alamos Scientific Lab., N. Mex.). Apr 1972. Contract W-7405-eng-36. 7p. Dep. NTIS.

The common occurrence of electron temperatures of a few hundred electron volts in θ-pinch experiments is shown by simple analytic arguments to be rather tightly determined by a balance between energy gained from collisions with the much higher-temperature ions and thermal conduction to material walls. It is also shown that electron thermal conduction should not cause a greater loss of energy from straight θ pinches of any length than ion end loss unless rather large magnetic-mirror ratios can be obtained. This applies in particular to straight θ-pinch fusion feasibility experiments and fusion reactors. Electron temperatures between 550 and 600 eV are predicted for the new 5-meter linear θ pinch now being built at The Los Alamos Scientific Laboratory. (auth)

37632 (ORO-4211-3) NUMERICAL SOLUTION TO THE VLASOV-POISSON EQUATIONS AND TO THE SIMPLIFIED FOKKER PLANCK-POISSON EQUATIONS. Estabrook, Kent; Alexeff, Igor (Tennessee Univ., Knoxville (USA). Plasma and Electro-Optics Lab.). [1971]. Contract AT(40-1)-4211. 10p. Dep. NTIS.

A fast finite-difference method is reported for the dynamics of the ion distribution function. The method may be easily extended to solve a simplified Fokker—Planck equation. The algorithm can adapt very flexibly to time varying boundary conditions. (auth)

37633 SYNTHESIS OF QUASI-STATIC AND IMPACT APPROXIMATIONS IN THE THEORY OF HYDROGEN LINE BROADENING IN PLASMA. Lisitsa, V. S. (Inst. of Atomic Energy, Moscow). Dokl. Akad. Nauk SSSR; 201: No. 4, 823-6(1 Dec 1971). (In Russian).

The theory of Stark broadening of spectral lines in a plasma is based on two alternative approximations: quasi-static and impact. A clear, analytical expression for hydrogen line profile in a plasma, which synthesizes the results of these two approximations, is obtained. (K.S.W.)

37634 INTERACTION BETWEEN AN ELECTRON BEAM AND A TURBULENT PLASMA. Eichler, Ray; Hutter, Rudolf; Levi, Enrico (Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.). J. Appl. Phys.; 43: No. 7, 3057-9(Jul 1972).

The growth of beam-current-density fluctuations along an electron stream passing through a turbulent plasma slab is discussed. (auth)

37635 TIME CORRELATION FUNCTIONS FROM THE BOLTZMANN EQUATION. Hauge, E. H. (Norges Tekniske Hoegskole, Trondheim). Phys. Rev. Lett.; 28: No. 23, 1501-3(5 Jun 1972).

It is shown that the nonlinear Boltzmann equation, as opposed to its linearized version, predicts time correlation functions with asymptotic tails $\simeq ct^{-3/2}$, and with coefficients c in agreement with recently obtained results. The appropriate specialization of the mode—mode formula is also shown to follow from the nonlinear Boltzmann equation. (auth)

37636 SCATTERING FUNCTION OF A SOFT COLLISION PLASMA. Cheng, Chiang S. (East Stroudsburg State Coll., Pa.); McLennan, James A. Phys. Fluids; 15: No. 7, 1285-91(Jul 1972).

The effects of collisions on the scattering function of a fully ionized gas and on the related functions describing conductivity and energy loss of a test particle are discussed, using a simplified Fokker–Planck collision model that preserves certain important features of the long-range small-angle soft collisions. The dispersion relations are discussed in detail, and explicit calculations are carried out for the scattering function and the energy-loss function in the long-wavelength approximation when the wavelength is longer than the mean free path and the Debye length. The damped plasma oscillation poles dominate the energy-loss function, while for the scattering function the ambipolar diffusion dominates the low-frequency region. (auth)

37637 COMPUTER SIMULATION OF PLASMAS. Dawson, John M. (Princeton Univ., N. J.). Astrophys. Space Sci.; 13: No. 2, 446-67(Oct 1971).

Work that has been carried out at Princeton and at the Naval Research Laboratory is reviewed. To a large extent this work has been devoted to electrostatic particle models. Some work on the Fourier–Fourier transform method for solving the Vlasov equation is mentioned. (W.D.M.)

37638 NONLINEAR EFFECTS IN THE INTERACTION BETWEEN AN ULTRARELATIVISTIC ELECTRON BEAM AND PLASMA. Breizman, B. N.; Ryutov, D. D.; Chebotaev, P. Z. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1409-23(Apr 1972). (In Russian).

The problem of stationary injection of an ultrarelativistic electron beam into a semi-space filled with plasma is considered. The problem is solved within the framework of weak turbulence theory for conditions when interaction between oscillations excited by the beam is significant. The main interaction mechanism (induced oscillation scattering by plasma ions) is determined, and the beam slowing-down length with allowance of the process is found. It is demonstrated that as relaxation proceeds, the angular spreading of the beam increases up to $\Delta\theta \sim 1$. Variation of the plasma parameters under action of the beam is investigated. It is found that in a dense plasma, disruption of relaxation due to density inhomogeneities, which are produced, may lead to the formation of a so-called relaxation wave which propagates in the plasma with ultrasonic velocity. (auth)

37639 INVESTIGATION OF NONLINEAR INTERACTION BETWEEN A FAST ION BEAM AND PLASMA ELECTRONS. Gabovich, M. D.; Soloshenko, I. A.; Simonenko, L. S. (Inst. of Physics, Kiev). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1369-75(Apr 1972). (In Russian).

Nonlinear interaction between an ion beam and a plasma is investigated under conditions when the beam velocity exceeds the thermal velocity of the plasma electrons. As in the case of an electron beam, restriction of the current oscillation amplitude is related to wave overturning in the region of the phase focus. Restriction of the potential oscillation amplitude is related to a different nonlinear mechanism, viz. to plasma electron capture by the wave field. The effect could be observed because of the specificity of nonlinear interaction between the ion beam and plasma in which capture of plasma particles by the wave field in certain cases occurs before the phase focus. It is also shown that nonlinear interaction leads to heating of the plasma electrons and to energy losses of the beam. (auth)

Production

37640 (CEA-R–4299) INTERFEROMETRIC STUDY OF THE EXPANSION OF A PLASMA CREATED BY A LASER. Schirmann, Daniel; Rabeau, Maxime; Tonon, Gianfranco (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes); Grelot, Philippe (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr 1972. 65p. (In French). Dep. NTIS (U. S. Sales Only).

An interferometric device was used to study the expansion of a plasma from the moment when it was created by a laser until the end of the laser pulse. The device utilizes a JAMIN interferometer and is provided with an ultrahigh-speed electronic camera. A fraction of the laser beam, which creates the plasma, is used as the light source. The temporal resolution of the assembly is ensured by an exposure time of 10^{-9} s, which in conjunction with a plasma expansion velocity of 10^{7} cm/s, produces a spatial resolution of 100μ. The plasma is produced by focusing a beam, (1.06μ) emitted by a Nd-doped glass laser (30 ns, 100 J), into a polyethylene target. The expansion of a plasma in vacuum was investigated. The effects of this expansion on inertial confinement due to the presence of residual gas, and on magnetic confinement (300 kG) were studied. The interferograms were used to calculate: the total number of electrons in the plasma and the changes in this number occurring during the laser pulse; the spatio–temporal electron density distribution; the expansion velocity of the plasma. (auth)

37641 ELECTRIC-DISCHARGE SHOCK TUBE AS A PLASMA FLOW SOURCE FOR MAGNETOHYDRODYNAMIC EXPERIMENTS. Maksimov, A. M. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 9: No. 5, 931-6(Sep-Oct 1971).

Translated from Teplofiz. Vys. Temp.; 9: No. 5, 1023-8(Sep-Oct 1971).

The results are discussed for an integrated investigation of the parameters of a shock-heated gas in an electric-discharge shock tube without diaphragms for an initial pressure range of 0.5 to 5 mm Hg and a Mach number range of M_S = 6 to 13. The velocity of the co-current plasma flow, the gas pressure, and the flow of heat to the shock-tube wall, as well as the length of the "plug" were measured. It is shown that the Rankine–Hugoniot equations can be used to calculate the gas-flow properties in the range under consideration. The process of ionization relaxation behind the shock-wave front was studied. Experiments were performed to study the interaction between the plasma flow and crossed electric and magnetic fields. (auth)

37642 POPULATION INVERSION IN LASER PLASMAS. Peyraud, J.; Peyraud, N. (Observatoire, Nice). J. Appl. Phys.; 43: No. 7, 2993-6(Jul 1972).

The conditions are defined for which a population inversion with respect to the ground state, due to recombination at high electron densities, can appear in cold laser plasmas. The interest of giant and short laser pulses for producing such plasmas is pointed out. (auth)

Stability

Refer also to abstract 37712.

37643 (ORNL-TM–3812) NONLINEAR EVOLUTION OF FLUTE-LIKE PLASMA MICROINSTABILITIES. Crume, E. C. Jr. (Oak Ridge National Lab., Tenn.). May 1972. Contract W-7405-eng-26. 111p. Dep. NTIS.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The evolution of linearly unstable, high-frequency ($\omega \approx n\Omega$), flute-like ($k_{||} = 0$), electrostatic modes that can occur in a multicomponent, magnetic-mirror-confined collisionless plasma was studied by a computer simulation. An infinite, periodic, sheet charge model was used in which particle motion is followed in one spatial coordinate and two velocity coordinates normal to a constant magnetic field. Approximately one quarter of the particles in the initial velocity distributions formed a warm, Maxwellian background component; the remainder belonged to a hot, linearly stable, loss-cone component. These velocity distributions were constructed in such a way as to provide initial states relatively free of randomly fluctuating electric fields. The early evolution of single-wave (either traveling or standing), resonant instabilities agrees well with linear theory. A rapid, coherent heating of the warm component occurs, and spatial harmonics of the unstable wave appear. The electrostatic field of the wave then saturates at an energy level as much as two orders of magnitude lower than those reported in previous simulation studies of the same and related instabilities or predicted from earlier nonlinear analysis. The field amplitude decreases rapidly to zero after saturation and then grows again nonlinearly. The temperature of the warm component reaches a maximum when the field amplitude vanishes. During and subsequent to this nonlinear growth period, details of the evolution of the field amplitude vary from case to case. The saturation levels and early postsaturation behavior are in agreement with a recently reported nonlinear analysis which was motivated by the simulation results. (M.O.W.)

37644 (TRITA-EPP–72-6) ON THE STABILITY OF PLASMAS PENETRATED BY NEUTRAL GAS. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 2 Apr 1972. 32p. Dep. NTIS (U. S. Sales Only).

The effects of plasma–neutral gas interaction, finite resistivity, and viscosity on the gravitational modes in permeable and impermeable plasmas are investigated in terms of a zero-order localized perturbation analysis: (i) At plasma densities n less than or comparable to the critical value $n_c \simeq 10^{20}$ m^{-3}, laboratory plasmas are permeable to neutral gas, whereas they become impermeable in the density range well above n_c. Tokamaks belong to the class of permeable plasmas. (ii) The growth rates of ballooning modes are too slow to be distinguished from the loss rates by other mechanisms during ordinary operation of tokamaks. (iii) When attempts are made to approach and exceed the critical density n_c in Tokamaks, an unstable situation should arise due to a steepening of the density gradient near the plasma boundary and to the large connection length of the magnetic field lines. This may explain the obtained density limit in tokamak experiments, as well as the observed proportionality between the plasma energy and the square of the ohmic heating current. (iv) In an impermeable plasma, the driving mechanism of the flute instability can be avoided in the plasma interior, and can be localized to a narrow partially ionized boundary region. Within the latter, plasma—neutral gas collisions and viscosity strongly reduce the growth rates of the flute instability calculated from the present theory. Further reductions of these growth rates are expected from a more advanced approach taking nonlinear and higher order effects into account, such as the overlapping effects of slowly growing ion and electron density perturbations. (auth) (Sweden)

37645 ANALYSIS OF HYDROMAGNETIC PLASMA STABILITY BY THE FINITE-ELEMENT METHOD. Ohta, M.; Shimomura, Y.; Takeda, T. (Japan Atomic Energy Research Inst., Tokai). Nucl. Fusion; 12: No. 2, 271-2(Mar 1972).

The stability problem of a cylindrical plasma immersed in a uniform axial magnetic field and bounded by a conducting shell is solved by reducing it to an eigenvalue problem of matrices, using the finite-element method. (M.O.W.)

37646 DISCONTINUITIES IN A COLLISIONLESS PLASMA FLOW HAVING A STRONG MAGNETIC FIELD. Morioka, Shigeki; Matsumoto, Yasuji (Osaka Univ.). J. Phys. Soc. Jap.; 32: No. 6, 1627-35(Jun 1972).

Discontinuities in a collisionless anisotropic plasma flow having a strong magnetic field, their evolutionary condition, and the hose and mirror instability conditions for associated flow are considered on the basis of Chew, Goldberger, and Low theory. Zero heat fluxes are assumed in both sides of the discontinuity, and the energy equation for transverse thermal motion is replaced by the adiabatic relation. Solutions are presented analytically and numerically for special angles of discontinuity and special upstream conditions. As a conclusion, it is found that remarkable differences exist between the CGL discontinuity and MHD shock wave. (auth)

37647 PLASMA INSTABILITIES IN HIGH-CURRENT FIELD-EMISSION DIODES. Toepfer, Alan J.; Bradley, Laird P. (Sandia Labs., Albuquerque, N. Mex.). J. Appl. Phys.; 43: No. 7, 3033-6(Jul 1972).

Striations in electron-energy-deposition profiles from high-current field-emission diodes utilizing razor-blade cathodes were observed. The variation of wavelength in the striations with cathode geometry indicates that the current-carrying plasma at the surface of the cathode undergoes a tearing instability during the initial stages of breakdown. (auth)

37648 ELECTRON CYCLOTRON DRIFT INSTABILITY AND TURBULENCE. Forslund, D. (Los Alamos Scientific Lab., N. Mex.); Morse, R.; Nielson, C.; Fu, J. Phys. Fluids; 15: No. 7, 1303-18(Jul 1972).

The linear theory of the electron-cyclotron drift instability, including off angle and collisional effects, is discussed in the context of applications to controlled fusion and collisionless shocks. With the help of numerical simulations it is then shown in detail that a strong nonlinear development of the instability causes anomalous resistance to current flow perpendicular to magnetic field lines, which is large enough to be consistent with the anomalous diffusion seen in these applications. In particular, a repeated trapping and untrapping of electrons in combined electrostatic—magnetic wells is an essential part of the nonlinear resistive heating process. A relatively steady resistance and turbulence level is seen, in contrast with the short burst of turbulence produced by many magnetic-field-free beam—plasma instabilities. (auth)

37649 MECHANISM FOR ANOMALOUS CURRENT PENETRATION. Horton, Wendell Jr. (Univ. of Texas, Austin). Contract AT(40-1)-3458. Phys. Rev. Lett.; 28: No. 23, 1506-8(5 Jun 1972).

A localized collisionless instability that occurs in a nonuniform or skin current flowing along an external magnetic field is shown to produce an anomalous viscosity giving cross-field diffusion of the current. The instability can occur under conditions where the ion-sound wave is stable and is then the dominant process for penetration. (auth)

37650 STABILITY OF INHOMOGENEOUS TWO-STREAM PLASMA WITH A WATER-BAG MODEL. Bertrand, P.; Doremus J. P.; Baumann, G.; Feix, M. R. (Univ., Nancy). Phys. Fluids; 15: No. 7, 1275-81(Jul 1972).

The problem of the stability of a one-dimensional inhomogeneous electron plasma in a fixed ion background is considered, using the water-bag model with N contours with only those instabilities appearing through the point $\omega = 0$. For marginal stability, the system of N water-bag equations is shown to degenerate into a single equation, and the stability property is simply connected to the sign of the eigenvalues of the Schrödinger operator $\{k^2(x) - d^2/dx^2\}$, where $(-k^2)^{1/2}$ is the local maximum wavenumber of instability. Finally, this criterion is checked for a simplified inhomogeneous two-stream situation described by a water-bag model with only two contours. (auth)

37651 LINEAR FEEDBACK STABILIZATION SYSTEM FOR SCYLLAC. Call, D. L.; Gribble, R. F.; Siemon, R. E. (Los Alamos Scientific Lab., N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 343-5(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A linear feedback stabilization system is being designed, tested, and constructed for the 5-m toroidal sector of Scyllac. Each closed loop consists of an optical plasma position detector, resolver and preamplifier, power amplifier, and one-turn load coil to apply the magnetic field for plasma position control. This paper describes the entire system; however, the major engineering effort is on the power amplifier. The final stage of each closed loop in the linear power amplifier is made up of two Machlett ML-8618 magnetically beamed power tubes operated in push-pull at plate currents up to 500 amperes. The output is coupled through a step-down transformer to the load so that up to 5 kA will be available for plasma position control. The design goal is to have a risetime of 0.2 μsec in the load coils. There are thirty closed loops which together can provide a peak power of 1 GW. (auth)

37652 NONLINEAR THEORY OF DISSIPATIVE INSTABILITY OF A RELATIVISTIC BEAM IN A PLASMA. Abramovich, V. U.; Shevchenko, V. I. (Physical-Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1386-91(Apr 1972). (In Russian).

Dissipative instability of a monochromatic relativistic beam in a plasma with frequent collisions $\nu > \delta$ (δ is beam instability increment) is investigated in the quasi-linear approximation in the absence as well as in the presence of a strong external magnetic field. It is shown that the energy lost by the beam during development of such instability is mainly expended in increasing the thermal energy of the plasma particles. The energy of the oscillations generated during the instability is small (by δ/ν times). (auth)

37653 STABILITY TO LOCALIZED MODES FOR A CLASS OF AXISYMMETRIC MAGNETOHYDRODYNAMIC EQUILIBRIA. Kueppers, G.; Tasso, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch.; 27a: No. 1, 23-6(Jan 1972).

Mercier's criterion is computed numerically for an exact class of axisymmetric MHD equilibria having possibly elliptical cross sections and a flat current profile. The main result is that the toroidal current density and the plasma beta can be increased by one order of magnitude if a) the eccentricity of the magnetic surfaces, b) the poloidal current, and c) the aspect ratio are adequately chosen, and if the ellipses are vertical. (auth)

Thermonuclear Processes

37654 (BNL-16748) DESIGN AND ECONOMICS OF LARGE DC FUSION MAGNETS. Powell, James R. (Brookhaven National Lab., Upton, N. Y.). 1972. 8p. (CONF-720513-5). Dep. NTIS.

From Applied superconductivity meeting; Annapolis, MD. (1 May 1972).

Projections are made for superconductor costs for dc fusion magnets, assuming superconductor production levels appropriate to an economy some time after 2000 AD in which a large fraction of the new electrical power plants are fusion reactors. The detailed projections are made on the basis of present (1971) conductor characteristics and processing technology. It is found that the very great increase in production of superconductor material that would be associated with a fusion power reactor economy should greatly reduce superconductor cost, in some cases by more than an order of magnitude. No allowance is made for large-scale production for other purposes, which well may be the case, and which should lead to even lower costs. It is also found that material costs should strongly dominate total conductor cost. The projected conductor costs amount to only a few \$/kW(e) for the fusion reactor designs that have been proposed, and are almost an order of magnitude smaller than magnet structure costs. (auth)

37655 (CONF-720515-2) TRITIUM HANDLING PROBLEM IN CONTROLLED THERMONUCLEAR REACTORS. Fraas, A. P. (Oak Ridge National Lab., Tenn.). 1972. 23p. Dep. NTIS.

From fourth annual Spring meeting of the Metallurgical Society of AIME; Boston, MA. (8 May 1972).

The tritium handling problem is described for a typical toroidal reactor. The limitations on tritium concentration are discussed in relation to economics of fuels and environmental considerations. Tritium recovery systems are also discussed. (M.O.W.)

37656 (UCRL-51151) THEORY AND OBSERVATIONS OF ELECTRON DISTRIBUTIONS IN THE QUIESCENT E-LAYER OF THE ASTRON. Humphries, Stanley Jr. (California Univ., Livermore. Lawrence Radiation Lab.). 15 Oct 1971. Contract W-7405-eng-48. 262p. Dep. NTIS.

Thesis.

Times during which the E-layer can be considered in a quasi-equilibrium state are studied. Theoretical models demonstrating factors affecting the spatial distributions are discussed. In order that the models were versatile enough to compare with obtainable experimental data, certain simplifications were used. Self-consistent equilibria of the E-layer are studied by the use of moment equations in special geometric cases. Spatial distributions in the axial and radial direction are found which are functions of applied magnetic fields, self-magnetic fields, and spreads in the average transverse velocity. The development of optical diagnostics which for the first time make it possible to accurately measure the radial distribution of electrons in the E-layer is described. The diagnostics are nonperturbing and permit time-resolved measurements. A complete experimental verification of the above models is given. This includes observations of the density which show an excellent agreement with the fundamental radial mode of the diffusion theory, observations of radial spreading due to diffusion, radial boundaries, and energy loss due to collisions with the background gas. Measurements of axial distributions also show very good agreement with predictions of the time-dependent distributions from the diffusion theory. With a small normalization correction, the theory predicts consistently the observed loss rates of electrons from the E-layer with self-field effects included. (M.O.W.)

37657 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. VOLUME 6, NO. 4, 1972. Bibliography, Author Index, Subject Index, Appendix. Frankfurt am Main; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 50p.

This listing contains 236 references on various aspects of the subjects above. (M.O.W.)

37658 INVESTIGATION OF MAGNETIC FIELD ERRORS IN THE SUPPORTED SPHERATOR. Okabayashi, M.; Freeman, R. (Princeton Univ., N. J.). Phys. Fluids; 15: No. 7, 1346-52 (Jul 1972).

The effect of slight asymmetry of the magnetic field in an azimuthally symmetric toroidal machine is investigated in the spherator by applying an additional uniform horizontal magnetic field. The azimuthal distribution of plasma loss across the magnetic field is varied by changing the direction and the strength of the additional horizontal magnetic field. Numerical calculations are carried out and possible initial field error is discussed by comparing the experimental results and an analytical calculation. By canceling the initial field error with the additional magnetic field, the particle loss becomes uniform in the azimuthal direction, but no significant change is observed in the confinement time in the argon afterglow plasma. (auth)

37659 NUCLEAR PUMPED GAS LASERS. Thom, Karlheinz (Atomic Energy Commission, Washington, D. C.); Schneider, Richard T. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 10: No. 4, 400-6(Apr 1972).

New areas in plasma physics and plasma dynamics are entered by research on gas lasers directly excited by nuclear reactions. Recent development of high-power, high-pressure gas lasers results in improved aspects of laser pumping by nuclear energy. Population inversion in gaseous laser media can occur as a result of interactions with fission fragment, α particles, fast protons, or γ rays. Such interactions may be the sole cause of population inversion or they may augment other means of laser pumping. The possibilities of achieving population inversion by nuclear reactions are discussed. Work in this field is reviewed and suggestions for further research are made. (auth)

37660 PROCEEDINGS OF THE FOURTH SYMPOSIUM ON ENGINEERING PROBLEMS OF FUSION RESEARCH, WASHINGTON, D. C., 20-23 APRIL 1971. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 1-429(Aug 1971). (CONF-710418).

Separate abstracts were prepared for 41 of the 61 included papers. The remaining 20 papers have previously appeared in NSA; see CONF-710418 in the Report Number Index for abstract numbers. (M.O.W.)

For abstracts of individual papers see: 36280, 36281, 37596–37598, 37651, 37661–37694, and 37819.

37661 ENERGY RESOURCES FOR POWER PRODUCTION. Hubbert, M. King (Geological Survey, Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 18-35(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The world's energy resources suitable for power production are reviewed. The topics briefly discussed include the following: (1) growth of power production, (2) growth of industrial energy production, (3) future of the fossil fuels, and (4) other conventional sources of energy. (M.O.W.)

37662 PRINCETON'S SYMMETRICAL TOKAMAK FROM PROPOSAL TO PLASMA IN 8 MONTHS. Bushnell, C. W.; Grove, D. J.; Joyce, J. B. (Princeton Univ., N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 37-41(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Although the original design of the Model C Stellarator facility allowed for a great amount of flexibility with a "race-track" geometry, conversion to the circular geometry required for the Symmetrical Tokamak presented a number of special engineering problems. This paper summarizes and details the various changes required to meet the Tokamak concept, including: major machine operations on the structural members of the stellarator, addition of confining field coils and special vertical field loops, a copper liner used for plasma stabilization, the new and larger-diameter vacuum system and, finally, the changes in the ohmic-heating coupling transformers. (auth)

37663 ORMAK FACILITY. Halchin, W. (Oak Ridge National Lab., Tenn.); Clarke, J. F.; DeCamp, S. M.; (and others). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 42-8(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Fabrication of ORMAK was started in the first half of 1970. By midyear the advance in theoretical understanding of the tokamak plasma suggested an improved device with expected plasma ion temperatures greater than 1 keV at a density of $\sim 5 \times 10^{13}$ cm^{-3}. The design was revised accordingly in August 1970. Since most of the basic pieces of the original design were used, the time schedule was not affected greatly. Assembly of ORMAK was started in November and was completed in January 1971. This paper describes the design and construction of the ORMAK device. (auth)

37664 DOUBLET II DESIGN CONSIDERATIONS. Schupp, Arthur A.; Jensen, Torkil H.; Ohkawa, Tihiro (Gulf General Atomic Co., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 55-9(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Doublet II is a device for the study of collision-free toroidal confinement and heating of plasma in which the main features of a tokamak and multipole (quadrupole) are combined. The major advantage that Doublet devices have over tokamaks is that β (ratio of plasma pressure to magnetic pressure) is more than an order of magnitude greater for devices with similar plasma parameters. The quadrupole-like field is obtained by a proper choice of plasma cross section and magnetic boundary condition. The cross section is defined by a tungsten limiter inside a thin, bakeable stainless steel hot liner, and the required boundary condition is obtained by surrounding the plasma with a close-fitting conducting shell, the field shaper. A toroidal magnetic field is produced by a 48-turn picture-frame coil. The coil is energized by a 10-MW lead–acid battery which produces a 10,000-G field at the average plasma radius of 60 cm. The toroidal plasma current which reaches about 350 kA in 20 msec is induced by current in a coil placed outside of the field shaper and vacuum tank. An important consideration in the design of this coil is the minimization of field errors associated with gaps in the field shaper. This coil is energized by a system of capacitor banks, chokes, switches, etc., which makes programming of the plasma current possible. (auth)

37665 CONFINING FIELD COILS FOR ATC. Citrolo, J. C.; Johnson, H. G.; Linton, T. W. (Princeton Univ., N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 77-82 (Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The engineering design and fabrication of the 24 wedge-shaped coils that produce the toroidal confining field for the ATC machine are described. The coils have 10 turns with a 45-inch I.D. and 57-inch O.D. They are designed to produce 90,000-gauss pulsed field at the inner torus radius and 23,000 gauss at mid-radius.

Stress analysis for the 380,000-pound centering force is presented. (auth)

37666 TOROIDAL MAGNET OF FM-1. Bonanos, P. (Princeton Univ., N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 83-4(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The construction features of the toroidal field coil for the FM-1 device are described. The coil is rated at 1.5×10^6 ampere-turns steady and has a field volume of 49 cubic meters. The stored energy of the field is nearly 2 MJ. The coil must be taken apart for insertion of a superconducting ring; the techniques for accomplishing this are described. (auth)

37667 FLOATING-RING STABILIZATION SYSTEM. Pelovitz, M.; Heim, W. J.; Murray, J. G. (Princeton Univ., N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 91-5 (Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The necessity of magnetically levitating a superconducting, current-carrying ring without mechanical supports requires an electrical stabilizing system. The ring, when supported, has only one equilibrium position and this position is one of unstable equilibrium. The ring is free to move with up to six degrees of freedom. Two degrees are dictated by the ability of the ring to move in any direction in the plane of the ring. Additionally, the ring can be tilted, requiring three more reference points to determine a new plane. The sixth degree of freedom is the ability of the ring to rotate upon its own axis, but because external forces tending to cause this rotation can, in principle, be eliminated, a restoring supply is not provided. Each of the five identical stabilizing supplies in this system has a feedback loop composed of the following segments. The position detector element is an optical head that sends a light beam across an optical edge on the ring, the reflection of which is sensed on a photo diode. This diode voltage signal, proportional to the ring position, is the input to an amplifier whose output is a signal proportional to position, velocity and ring acceleration. A 50-volt, 100-ampere, bidirectional dc transistor power supply is activated from this signal, which in turn powers the appropriate stabilizing coil located near the floating current-carrying ring. A J X B force is produced in a direction to restore the ring to its equilibrium position at which time the stabilizing coil currents return to approximately zero, minimizing any effect upon the experiment. The design and construction details of this system are discussed. (auth)

37668 MINI-COMPUTER DATA ACQUISITION STATION. Bennett, F. K.; Mayercak, J. J.; Schweitzer, S. (Princeton Univ., N. J.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 113-17(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A PDP-8/I mini-computer was used as a satellite data-acquisition station in conjunction with a larger, central IBM-1800 computer. An analog data interface to the PDP-8/I permits bipolar analog data to 10-bit accuracy to be collected at the rate of one analog sample every 1.5 μs. (auth)

37669 100-MHz AND 100-MBIT RECORDING AND READOUT INSTRUMENTATION SYSTEMS FOR ELECTROMAGNETIC FIELD PERTURBATIONS. Pass, H. W.; Wood, John (Resalab, Inc., Los Angeles). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 118-23(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The requirement for a wideband recording capability for instrumenting electromagnetic fields with nanosecond rise-time perturbations and long-duration reactions led to the development of a modulated laser-beam analog recorder. The original concept of the recorder yielded 100-MHz bandwidth records of ± 40 db dynamic range of approximately 25-μsec duration but required synchronization of the event to the rotating mirror camera of the recorder. Normalization of data required digital computer processing of densitometer conversion of film-density data to analog electrical signal. An improvement of the original system, which permits continuous recording up to several minutes at 100 Mbit digital writing, solves the major shortcomings of the analog recorder. Using techniques of signal conditioning and laser-beam splitting and modulation of the previous system, the data stream is split into four channels recorded simultaneously and continuously on moving 70-mm film in a four-to-one interlace pattern. Each channel is organized into discrete blocks with data-synchronizing words to provide block and timing identification. The physical arrangement of the recorder is such that film readout is effected on the same transport deck. Simultaneously scanned data tracks generate a parallel serial data train which is buffered, multiplexed, and recombined to produce the serial data stream. (auth)

37670 COMPUTER PROCESSING OF PLASMA DATA UTILIZING A FAST-FOURIER-TRANSFORM-GENERATED SPECTRAL ANALYSIS APPROACH. Smith, D. E.; Powers, E. J.; Rowberg, R. E. (Univ. of Texas, Austin). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 124-36(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A method of plasma wave diagnostics using digitally computed power spectral density functions is described. The process involves application of the fast Fourier transform algorithm to digitally converted analog plasma data in order to generate the standard auto- and cross-power density spectra as well as other useful spectral functions. (auth)

37671 MECHANICAL ASPECTS OF THE IMP MIRROR-QUADRUPOLE FACILITY. Wells, E. R.; Dunlap, J. L.; Culver, J. S. (Oak Ridge National Lab., Tenn.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 137-43 (Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Mechanical details of work toward the complete facility are reviewed. The effort involved construction of not only the quadrupole coil set, but also a new microwave cavity, helium container, and radiation shield to accommodate the full coil assembly. (M.O.W.)

37672 VACUUM DESIGN FOR ATC. Citrolo, J. C.; Mullaney, D. H. (Princeton Univ., N. J.). Contract AT(30-1)-1238. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 150-4(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The parameters for the design of vacuum vessels for plasma physics experiments usually are base pressure required, plasma volume, and the geometry of the magnetic field coils. For the Adiabatic Toroidal Compressor (ATC) machine now being constructed at Princeton, the plasma's major and minor diameter changes during compression, and the compression field rise time requires a high electrical resistance for the vacuum vessel. These additional parameters dictate a unique vacuum vessel design. The geometry, construction details, and stress considerations for this design are discussed. (auth)

37673 AUXILIARY COIL SYSTEM FOR SCYLLAC. Borkenhagen, W. H.; Ellis, W. R.; Harris, H. W.; Zimmermann, E. L. (Los Alamos Scientific Lab., N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 155-62(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The system of auxiliary $l = 1$ and $l = 0$ coils for the toroidal Scyllac and Scylla IV-3 θ-pinch experiments at LASL is described in detail, including theory of operation, coil design constraints, method of construction and test, and installation configuration. These coils produce magnetic fields of the general form sin $(l\theta - hz)$ which, when added to the axial θ-pinch field B, provide toroidal equilibrium and a means of feedback stabilization. Because these coils are subjected to both induced and applied voltages, the major engineering effort was directed toward achieving adequate electrical insulation in the limited space demanded by the low-inductance circuitry. This paper includes the step-by-step construction and test of a typical l-coil. Sophisticated epoxy potting, taping, and spacing techniques were successfully employed. Dc- and pulsed-voltage tests to above 100 kV were conducted prior to installation of the coils on the experiments. Electrical connections were made outside the θ-pinch coil in such a way as to cancel the induced voltages before they could reach the driving-capacitor banks. (auth)

37674 MAGNETIC GUIDE FIELD AND COMPRESSION SYSTEM FOR HIGH CURRENT ELECTRON BEAMS. Wildi, P.; Kolb, A. (Maxwell Labs., Inc., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 163-8(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

High-current relativistic electron beams can be injected into magnetic traps for plasma heating and containment. A two-meter beam-guidance system for injection and merging of two beams from synchronously fired accelerators is discussed. The beams are injected into a magnetic-mirror configuration with a mirror ratio of three. (auth)

37675 MARX AND MARX-LIKE HIGH-VOLTAGE GENERATORS. Fitch, R. A. (Maxwell Labs., Inc., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 190-8(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Major developments have taken place in the art of Marx generating in recent years. The rationales, modi operandi, and relative merits of these developments are discussed in an attempt at exegesis and classification. (auth)

37676 ENGINEERING ACTIVITIES AT CULHAM. Booth, J. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 199-204(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The main engineering activity at Culham at the time of the conference centered on the design and construction of three large experiments. The first of these, the High β Toroidal Experiment (HBTX), was commissioned in the summer of 1970 and had started on its experimental program. The second, the Superconducting Levitron, was due for completion by the end of 1971 and the stellarator CLEO in 1972. Other work at Culham included the development of a new modular low-inductance capacitor bank and fusion technology studies. (auth)

37677 PLASMA CONTAMINATION AND WALL EROSION IN THERMONUCLEAR REACTORS. Kaminsky, M. (Argonne National Lab., Ill.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 208-17(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Plasma radiations striking the vacuum walls of fusion reactors may (a) seriously damage and erode the wall and (b) release major quantities of gas that will contaminate the plasma. The influence of various secondary-particle emission contributing to these two processes is reviewed; special emphasis is given to radiation blistering, sputtering, and the release of gaseous particles by energetic photon impact. From the best estimates of the yields of some of these processes, the lifetimes of walls made, for example, of Nb or Mo are estimated. (auth)

37678 APPLICATION OF COMPUTER PROGRAMS IN THE DESIGN OF A FAST-REVERSAL THETA-PINCH EXPERIMENT. Duechs, D. F.; Young, M. P. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 224-9(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The confinement of plasma in a linear theta pinch should be improved by the application of rapid reversals of the direction of high magnetic fields. In order to create the complex currents for such fields, a multiplicity of capacitor banks with greatly different characteristics has to be utilized. The analysis of such a network is complicated furthermore by an important time-dependent inductance arising from the motion of the plasma. The system of differential equations for the currents and voltages at various circuit elements is nonlinear and can only be solved with the aid of computer programs. In an iterative process which compromises the plasma theory requirements and the hardware limitations, an attempt is made to optimize the design of the experiment. A description of this technique, examples for the variation of critical circuit parameters, and a possible design are presented. (auth)

37679 PROPOSED METHOD OF RATING FUSES FOR PULSED SERVICE. Murray, J. G.; Bronner, G. (Princeton Univ., N. J.). Contract AT(30-1)-1238. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 230-4(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

For many applications the present standard I^2t rating method for coordinating fuses is not satisfactory. Examples include the protection of solid-state devices without large safety factors, and high-voltage dc circuits. Therefore, an improved engineering and rating procedure for the application engineer is needed for such interrupting devices. This paper examines the problem and suggests a method for obtaining the arc voltage as a function of the circuit parameters and applying ratings based on this. The procedure is checked against test results for four types of fuses. (auth)

37680 ENERGY STORAGE CAPACITORS OF HIGH ENERGY DENSITY. Hoffman, P.; Ferrante, J. (Maxwell Labs., Inc., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 235-9(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The capacitor requirements of modern EMP generators are such that conventional energy-storage capacitors are not satisfactory. New concepts of capacitor design will make available high-energy-density units with reliable performance for future needs. A review of state-of-the-art energy storage capacitor characteristics is presented, delineating the effect of dominant operational mode on the physical shape and energy density of a number of capacitor types. A specialized configuration of energy-storage capacitor, tailored to the requirements of EMP generators, is described and its performance characteristics detailed. These new capacitor concepts may be applied to specific applications in fusion research under certain circuit conditions which are discussed. (auth)

37681 LOW-INDUCTANCE 120-kV ENERGY-STORAGE MODULE. Young, M. P.; Ford, R. D. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 240-2(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A low-inductance 120-kV energy-storage module was developed at the Naval Research Laboratory. Fifty of these modules operating in parallel form the 300-kJ capacitor bank for the fast-reversal field of the SWAP experiment. The module comprises two 60-kV, 1.85-μF capacitors operating as a modified Marx-type circuit. The self-inductance of the module, including the output switch and cable terminations, is approximately 110 nH. This arrangement has the advantage of using 60-kV power supplies, charging circuit, and capacitors for a 120-kV capacitor bank and eliminates one of the series fast synchronized switches with a concomitant inductance reduction. The bank construction cost was drastically reduced by the module physical arrangement. The second-stage capacitor is mounted upside down directly on the first-stage capacitor. The first-stage capacitor therefore acts as both the support and insulator for the second-stage capacitor, whose case rises to 120 kV above ground at discharge. (auth)

37682 ELECTRICAL DESIGN OF THE NRL GAMBLE II: 100-KILOJOULE, 50-NANOSECOND, WATER-DIELECTRIC PULSE GENERATOR USED IN ELECTRON BEAM EXPERIMENTS. Shipman, J. D. Jr. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 243-6(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Rationale for the choice of dielectric, size, and basic components of the system is summarized. The technology available and the state of the art in designing large water-dielectric energy-storage systems is discussed, and application of this technology to design of the Gamble II pulse generator is described. (auth)

37683 ANALYSIS OF COMPONENT FAILURE PROBLEMS USING PARTIALLY ORDERED SETS. Boicourt, G. P. (Los Alamos Scientific Lab., N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 247-50(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

It is often desirable, due to expense in time and money, to find the cause of component failures directly from available operational data rather than to resort to controlled tests. Such a method for analyzing component failures caused by manufacturing processing problems is illustrated by an application to a group of early failures among Scyllac capacitors. The application of the method proves that the failures were predominantly caused by inadequate drying of the capacitor packs. The method involves the use of partially ordered sets and can be considered as an abstraction of multivariate regression. The advantages and disadvantages of the method with respect to multivariate regression are discussed. (auth)

37684 CONTROLLED FUSION EXPERIMENTS AT THE NAVAL RESEARCH LABORATORY. Elton, R. C. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 251-4(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Plasma physics experiments oriented towards controlled thermonuclear fusion that have existed and are developing at NRL are summarized, with particular emphasis on recent technological experiences with the hard-core adaptation of the θ-pinch device. New experiments include a θ-pinch with rapidly tailored magnetic fields and an extended z-pinch initiated with a laser-triggered high-voltage streamer. Other active experiments of related interest to CTR are briefly described. (auth)

37685 PULSED-POWER TECHNOLOGY FOR CONTROLLED THERMONUCLEAR FUSION. Levine, L. S.; Vitkovitskii, I. M. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 255-64(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Over the past few years, the technology of pulsed power generators has been developed to the level where it is possible to produce powers of the order of 10^{12}W for times of the order of 10^{-7}sec. Such generators are most commonly utilized to produce intense relativistic electron beams, and this paper briefly surveys the existing state of the art of generators and relativistic beams. As examples, recent work at NRL is considered in some detail. Finally, several potential applications of this technology in controlled fusion research are discussed. (auth)

37686 IMP SUPERCONDUCTING COIL SYSTEM. Efferson, K. R.; Coffey, D. L.; Brown, R. L.; (and others) (Oak Ridge National Lab., Tenn.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 265-72(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A superconducting mirror quadrupole system was constructed at ORNL that will produce the magnetic field for the IMP experimental plasma physics facility. This coil system is shown schematically. Design work for this system started in the latter part of 1966. The NbTi mirror coils were completed and became operational in July 1969. The Nb$_3$Sn quadrupoles were completed and partially tested. The entire system had been assembled and was scheduled to become operational in April or May, 1971. The quadrupole coil design is discussed. (M.O.W.)

37687 TEMPERATURE MEASUREMENT OF AN ISOLATED ISOCHORIC DEWAR. Weissenburger, A. W. (Princeton Univ., N. J.). Contract AT(30-1)-1238. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 286-9(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The time limit of operation per liquid helium charge of the FM-1 dewar is determined by its thermal characteristics and the maximum allowable internal pressure. Efficient machine operation demands that as much operating time be obtained per helium charge as practical. It is, therefore, desirable to measure accurately the dewar temperature in order to cease operating shortly before the dewar's burst diaphragm operates to flood the vacuum system. This paper describes a telemeter system designed to monitor the temperature of an isolated dewar. The output frequency of the transmitter is made proportional to temperature via a current-controlled oscillator. Input is from the same temperature-dependent composition resistor sensors that are employed to determine dewar temperature in the nonisolated mode. Power is supplied to the dewar electronics via the inductively coupled telemeter link. (auth)

37688 COMMAND TRIGGERING OF SYNCHRONIZED MEGAVOLT PULSE GENERATORS. Markins, D. (Maxwell Labs., Inc., San Diego, Calif.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 296-302(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Two separated coaxial pulse-forming lines of 1.5 ohms impedance are simultaneously switched into 1.5-ohm coaxial transition lines in a water environment producing 70-ns-duration, 20-ns-risetime, 1-MV pulses into a common load. The pulse-forming lines are pulse-charged to voltages up to 2 MV in a time of about 0.5 μs from a common Marx generator. Feasibility of the command trigger design has been demonstrated on a single 1.5-ohm coaxial-line system. Four closely coupled trigatron-type gas/plasma switches are triggered simultaneously by a trigger generator mounted within the transition line. The command trigger pulse firing this trigger generator penetrates the outer and inner members of the transition line through an interface unit. The characteristics of the trigatrons, the trigger generators, and the interface units are described. (auth)

37689 FAST MULTICHANNEL FIELD-DISTORTION FOIL SWITCH FOR 500 kV. Dokopoulos, P. (Kernforschungsanlage, Juelich, Ger.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 303-7(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A field-distortion solid-dielectric switch was developed for starting water immersed capacitor banks with operating voltages up to 450 kV. It consists of two flat main electrodes insulated by two plastic foils, with a thin aluminum trigger strip embedded between them. A simple and cheap method is used for triggering by applying an ordinary 60-kV gas trigatron, i.e., no additional high-voltage pulse generator is needed. Depending upon the main voltage and upon the thicknesses of the insulating foils, 8 to 50 parallel breakdown channels were observed on a switch with a width of 20 cm. The time interval between the start of the trigger pulse and the closure of the switch (switching time) is typically 20 ns with a jitter of less than 3 ns; the resistive phase of the switch can be kept shorter than 3 ns. Due to multichannel breakdown and to the small electrode spacing resulting from solid dielectric insulation, the switch inductance, including the connection line, is only 9 nH, the major part being due to the connection. A 15-kJ bank with 300-kA maximum current was discharged by a single switch. (auth)

37690 FAST MULTICHANNEL CROWBAR SWITCH. Dokopoulos, P.; Lorbach, F. (Kernforschungsanlage, Juelich, Ger.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 308-13(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A field distortion switch is used for crowbar operation. It consists of two flat main electrodes with a metal sheet between them, dividing the switch into two gaps. Taking special precautions, it was possible with a single trigger source to break down both gaps. Reliable crowbar performance is possible with solid as well as with gas insulation. In both cases multichannel breakdown is achieved. Up to 200 breakdown channels were observed with solid and up to 10 with gas insulation. Tests were carried out using capacitor banks at voltages between 20 and 60 kV and with frequencies up to 250 kHz. Maximum currents varied between 20 and 300 kA. The larger current and voltage values were used with solid dielectric crowbar switches. The jitter time of the switching device is less than 10 ns, the major part being due to the trigger generator. (auth)

37691 LASER-TRIGGERED SOLID DIELECTRIC SWITCHING. Ury, M.; Morse, D.; Friedman, M. (Cornell Univ., Ithaca, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 314-21(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

A Q-switched ruby laser was used to initiate breakdown in solid dielectric switches with a jitter of less than 3 ns. "Lexan" polycarbonate in thickness from 40 to 80 mils withstood applied voltage pulses (less than 1 μs duration) of up to 400 kV. Laser pulse energy of less than 1 joule was sufficient to initiate breakdown in the solid dielectric. A focusing lens and the switch container were immersed in a grading solution of copper sulfate and water. Command triggering down to 50% of the dielectric's self break voltage was demonstrated. A test system employing a miniature Marx generator, and a high energy system switching 150 kA at 400 kV to form precisely timed relativistic electron beams are described. (auth)

37692 VERSATILE LOW-COST LABORATORY SWITCHES. Ford, R. D.; Young, M. P. (Naval Research Lab., Washington, D. C.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 331-7(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

The first switch discussed has a self-inductance of approximately 40 nH and operates over a voltage range from 0 to 60 kV. It is capable of switching from 1 to 500 J with a life expectancy in excess of 25,000 shots. The second switch extends the energy range from 500 J to 5 kJ with a reduced life expectancy corresponding to the increasing energy. It can be operated up to 20 kV and peak currents to 250 kA. This switch fits directly into any parallel-plate arrangement providing low inductance (less than 20 nH) for the switch and its terminals. All inclusive tests to determine the ultimate performance for all switch characteristics had not been made due to the variety of switch configurations. However, test results are presented which show typical performance characteristics as well as switch limitations. (auth)

37693 FAST HIGH-ENERGY SWITCH DEVELOPMENT FOR PLASMA FOCUS RESEARCH. Carpenter, J. P.; Williams, A. H.; Ware, K. D.; Bottoms, P. J.; Mather, J. W. (Los Alamos Scientific Lab., N. Mex.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 338-42(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

With the dense plasma focus it is important to maximize the delivered current. Through impedance matching considerations, it is evident that this requires higher voltage operation instead of increased capacitance for higher-energy systems. Graded vacuum switches were used with dc charged 50-kV, 10-kJ capacitor modules and with pulsed charged 50-kV, 17.5-kJ swinging Marx capacitor modules with good operation. For higher voltage operation a field-distortion pressure switch was developed and tested with a 60-kV, 26-kJ capacitor module. This switch should be useful at voltages up to 100 kV. (auth)

37694 PROCESS CONTROLLING A RESEARCH DEVICE. Simon, E. D.; Duritt, S. P. (Princeton Univ., N. J.). Contract AT(30-1)-1238. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 351-6(Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

Operation of the new FM-1 research device at the Princeton University Plasma Physics Laboratory utilizes an IBM 1800 Process-Controller for numerous control functions and extensive status indications and annunciation. This was the first use of a process-controller as a full experiment controller at PPL. Practical experience was gained in the hardware and software characteristics of such a control system, as well as methods of documentation. An optimum allocation of storage exists for a system of this type. A minimum core of 16,000 16-bit words plus executive is also required. Permanent core is used for those programmed actions requiring rapid response and insuring safety to personnel or equipment. Exchangeable core is used for supplementary functions and startup-energize operations. Timing functions are affected by the cyclic updating of input and output data and methods were developed to compensate for this. Documentation provides duplication of program cards, listings and disks as means of backup. Program links, messages and designations are logged. The drafting system allows for more rapid design of new controls as well as changes to present ones. (auth)

37695 CUMULATION OF ELECTROMAGNETIC PLANE FIELD AT RELATIVISTIC INITIAL VELOCITIES OF A CONDUCTIVE LINER. Kaliski, S. (Inst. of Fundamental Technical Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 2, 119-25(Mar 1972).

The plane problem of cumulation of a magnetic field by implosion of a heavy conductive liner into the field is considered for the case of quasi-relativistic velocities of the liner implosion. Solution of Maxwell equations with the boundary condition in the form of an ordinary differential equation was constructed based on the method of characteristics. In the special case $v/c \ll 1$, the known quasi-static solution of cumulation of the field is obtained. (auth)

37696 DUST NUCLEAR REACTOR. Pozwolski, Alexandre Edgar. French Patent 2,081,241. 3 Dec 1971. Filed 23 Mar 1970. (In French).

A nuclear reactor is presented in which the nuclear fuel is in the form of dust particles having a diameter of the order of 1 micron (named macrons). These macrons consist of light elements capable of undergoing fusion, e.g., deuterium, tritium, or lithium associated with Z715 elements such as bromine, iodine, or uranium (in a dilute and stabilized form). They may equally well consist of fissile elements, e.g., uranium or plutonium. These macrons are accelerated up to velocities between 100 and 1000 km/s and made to bombard a target. It is possible to cross two beams of fast macrons, direct one fast macron beam onto another, or direct a macron beam onto a heavy metal target. The impact causes a very hot and very stable plasma. The stability of the plasma may be even further improved by a 1 to 10-tesla field, which confines the cold electrons, the space charge created trapping the plasma. The macrons are accelerated using a linear accelerator. (France)

37697 CALCULATION OF AN ENCLOSED CYLINDRICALLY SYMMETRIC GREEN'S FUNCTION AND ITS COMPARISON TO FIELD MEASUREMENTS. Porter, G. D.; Weiss, P. B. (Univ. of California, Livermore). J. Appl. Phys.; 43: No. 6, 2635-9 (Jun 1972).

An analytic representation for the field from an arbitrary current distribution (either expandable in a Fourier series or for a current distribution that varies as $\sin^2 kz$ over one period) with cylindrical symmetry and enclosed within conducting inner and outer walls is derived. The Green's function applicable to the dc field from a single loop lying between two perfectly conducting cylinders is first calculated. The inversion from measured magnetic field to current distribution, which can be obtained in principle from the Green's function, is done in detail only for the previously mentioned current distributions. For most experimental parameters, the Green's function is so sharply peaked, one can assume a periodic current distribution for long current layers (length-to-diameter ratio >2). The predicted magnetic field amplitude and field shapes were experimentally verified on the Astron machine. (auth)

37698 FLUX CAPSTAN. Why, Frederick John. British Patent 1,276,127. 1 Jun 1972. Filed 22 Sep 1969.

Reference is made to superconductor loops used to shape an externally generated magnetic field into a complex configuration. Such a loop may comprise a single turn, or may be a winding, and it may be fixed or moveable to achieve a predetermined moving flux pattern. The loop described is referred to as a "flux capstan" and may be employed for creating convoluted flux patterns, such as for the purpose of plasma containment; it may also be made to track through a predetermined path so as to control a dynamic plasma situation. The arrangement comprises a superconductor loop arranged for rotational displacement about an axis in the plane of the loop, together with means for open-circuiting the loop to allow an externally generated magnetic field to penetrate it, and means for closing it to imprison the field which has penetrated the opened loop. The loop may be shaped to suit the configuration of the required magnetic field, and may be mounted in a rotatable gimbal. Means are provided for establishing a circulating electric current in the loop. Cooling ducts are arranged alongside the loop to maintain the superconduction temperature, and heaters may be provided to raise the temperature in localized regions above the superconduction temperature. A plasma-containing field generator is also described that includes at least one such flux capstan. (UK)

Wave Phenomena

Refer also to abstract 36854.

37699 (JINR–E9-6385) COMPUTER INVESTIGATION OF NONLINEAR DYNAMICAL PROBLEMS OF PLASMA THEORY. Makhan'kov, V. G.; Shchinov, B. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1972. 16p. (CONF-720423–2). Dep. NTIS (U. S. Sales Only).

From first European conference on computational physics; Geneva, Switzerland (10 Apr 1972).

Results of a numerical investigation of three plasma theory nonlinear problems are given: (1) evolution of the Langmuir wave spectra due to their induced scattering on plasma ions and four-plasmon interactions; (2) the correlation function structure of quasi-steady isotropic Langmuir turbulence; and (3) the dynamics of radiation instability of relativistic electron rings up to saturation. (auth)

37700 (ORO–3778-7) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF HARMONIC ION CYCLOTRON WAVE PROPAGATION AND PLASMA HEATING. Final Report. Kristiansen, M. (Texas Tech Univ., Lubbock. Plasma Lab.). 15 Feb 1972. Contract AT(40-1)-3778. 59p. Dep. NTIS.

A theoretical technique is presented which allows numerical investigation of wave propagation in a warm, bounded plasma. In this theory, all plasma dielectric tensor terms are expanded in power series of the hot plasma expansion parameter, and at some specified order, all series are truncated. The introduction of first- and higher-order correction terms, however, requires boundary conditions in addition to those on $\vec{E}_t$ and $\vec{H}_t$. Assuming a rigid plasma–vacuum boundary, the continuity of the normal electric field is proposed as one additional boundary condition. Numerical results are presented for the fast plasma wave propagating near the second harmonic of the ion cyclotron frequency. Under this condition, finite temperature effects predict a strong-wave-damping mechanism. This damping mechanism was observed experimentally, yielding basic agreement with the theory. The results, however, are not as detailed as are desired because of poor repeatability. This problem is still being investigated. Some of the problems one might expect to encounter in the application of rf plasma heating to a fusion reactor are also discussed. Problems with arcing and coil cooling are discussed and possible solutions are presented. (auth)

37701 (ORO–4211-1) SIMULATION OF ION ACOUSTIC WAVE AND PSEUDOWAVE GENERATION IN A PLASMA. Estabrook, K.; Alexeff, I. (Oak Ridge National Lab., Tenn. Tennessee Univ., Knoxville). [1971]. Contract AT(40-1)-4211. 30p. Dep. NTIS.

The unexpected effects of a grid in attempts to launch ion-acoustic waves are investigated. A time-varying potential on a grid was found inherently to produce ion bursts (pseudowaves) at all voltages and frequencies used. The voltages ϕ ranged from low ($e\phi = kT_i$), to medium ($e\phi = kT_e$), to high ($e\phi \gg kT_e$) in some cases where the electron to ion temperature ratio was large ($T_e/T_i = 30$). The frequencies f used ranged from below to above the ion plasma frequency f_{pi} ($0.25f_{pi} \leq f \leq 2f_{pi}$). Ion-acoustic waves, however, could be observed clearly only for low excitation voltages and for frequencies at and below the ion plasma frequency. In the computer simulation, the grid is treated as a one-dimensional source of potential, and particle absorption and scattering by the grid wires are neglected. A one-dimensional ion distribution function F(x,v,t) is found by numerically integrating the ion Vlasov—Poisson equations by a finite-difference method for phase space. Electrons are treated as a massless neutralizing fluid, and the electron density is computed by balancing the electric field against the thermal electron pressure in a self-consistent fashion ($n_e = n_0 \exp(e\phi)(\kappa T_e)^{-1}$). (auth)

37702 (ORO—4211-2) CHERENKOV ION ACOUSTIC RADIATION GENERATED BY A PSEUDOWAVE: EXPERIMENT, THEORY, AND SIMULATION. Estabrook, Kent; Alexeff, Igor (Tennessee Univ., Knoxville (USA). Plasma and Electro-Optics Lab.). [nd]. Contract AT(40-1)-4211. 14p. Dep. NTIS.

A pseudowave packet propagating at high velocity through a plasma is observed to generate a "wake" of ion acoustic waves radiating outward. When the pseudowaves are cut into laminations, a short sine wave train of ion acoustic waves is observed to propagate perpendicular to the pseudowave paths. The Cherenkov method may be an excellent method of exciting pure ion acoustic waves without the nonlinear sheath effects (streaming) inherent in the direct use of exciting electrodes. Discussed is a theory and simulation of the ballistic-wave coupling which predicts the observed waveform. (auth)

37703 (ORO—4211-6) GRID EFFECTS AND PSEUDOWAVES IN PLASMA. Progress Report. Alexeff, Igor (Tennessee Univ., Knoxville. Dept. of Electrical Engineering). [1971]. Contract AT(40-1)-4211. 88p. Dep. NTIS.

Experimental facilities and present projects for study of ion-acoustic waves, electron plasma waves, pseudowaves, and low- and high-frequency instabilities are briefly described. Some results of this study appear in five publications that are abstracted in this issue. See abstracts immediately preceding. (M.O.W.)

37704 (RISO—257) PROPAGATION PROPERTIES OF DENSITY PULSES AND ION ACOUSTIC WAVES IN COLLISIONLESS PLASMAS CALCULATED FROM THE LINEARIZED VLASOV EQUATION. Jensen, V. O.; Michelsen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Feb 1972. 33p. Dep. NTIS (U. S. Sales Only).

Calculations of the propagation properties of ion density perturbations and waves through collisionless plasmas with Maxwellian velocity distribution functions are presented. The calculations are based on the linearized Vlasov equation, which is solved with the perturbation as a boundary value. Solutions are presented for various values of the ratio between electron and ion temperature and for various drift velocities of the background plasma and of the perturbations at the boundary. Some of the results are compared with those obtained in a simple Landau treatment of the problem. (auth) (Denmark)

37705 NONLINEAR INSTABILITY OF LONGITUDINAL PLASMA OSCILLATIONS. Demchenko, V. V.; El-Naggar, I. A. (Atomic Energy Establishment, Cairo). Nucl. Fusion; 12: No. 2, 273-4(Mar 1972).

Longitudinal oscillations in a homogeneous plasma are described by an equation of the form $\epsilon(k,\omega)\ E + \lambda E^2 + \lambda^2 E^3 + \ldots = 0$ where E is the Fourier component of the electric field, $\epsilon(k,\omega) = \epsilon_1(\omega) + 3k^2\lambda_D^2$, $\epsilon_1(\omega) = 1 - (\omega_p^2/\omega^2)$ with λ_D being Debye length and ω_p the plasma frequency; λ is a small parameter characterizing the magnitude of the nonlinearity. An analysis is given for the basic fundamental resonance and for the demultiplication parametric resonance. (M.O.W.)

37706 PROPAGATION OF ION ACOUSTIC WAVES FROM AND TO A SPHERICAL OR CYLINDRICAL CONDUCTOR. Schott, L. (Univ. of Saskatchewan, Saskatoon). Can. J. Phys.; 50: No. 5, 506-12(1 Mar 1972).

Analytic expressions for the spatial variation of the phase velocity and amplitude of ion acoustic waves propagating radially through the plasma boundary layer at a conducting sphere or cylinder are derived using the two-fluid model. The Debye length is assumed to be small compared with any relevant dimension of the problem and the wavelength small compared with the radius of the conductor. The limits of ion mean free paths small and large compared with the radius of the sphere are considered. In the cylindrical case only the collisionless limit has a self-consistent solution. It is found that both the converging and the diverging waves are damped and that the phase velocity of the wave is approximately equal to the sum of the ion acoustic velocity in a homogeneous plasma and the ion drift velocity. The contribution of Landau damping to the total damping is estimated. (auth)

37707 CALCULATIONS ON ION WAVES IN RARE-GAS STRONG-CURRENT COLUMNS AT LOW PRESSURE. Wojaczek, Karl (Zentralinstitut fuer Elektronenphysik, Berlin). Beitr. Plasmaphys.; 11: No. 4, 335-50(1971). (In German).

The linear theory of the ionization waves is improved in the quasi-homogeneous approximation by special consideration of the temperature and concentration dependences of the energy loss rate, the temperature dependence of the electron mobility, and the thermal diffusion. It is shown how the self-excitation limit and the behavior of the ionization waves at the total current intensity can be obtained from complex 4th-degree dispersion equation. The relation found was tested on the strong-current column in Ar at low pressure. The deviations existing can be traced back to the still inadequate knowledge of some elementary initial data. Possible improvements of the theory are indicated. (tr-auth)

37708 PERTURBATION CALCULATION OF THE SCATTERING OF ELECTROMAGNETIC WAVES BY AN UNDERDENSE PLASMA LAYER. Klein, Milton M. (Air Force Cambridge Research Lab., Bedford, Mass.). IEEE (Inst. Elec. Electron. Eng.), Trans. Antennas; AP20: No. 1, 78-80(Jan 1972).

A perturbation technique was utilized to obtain the scattering of electromagnetic waves by an underdense plasma layer for Gaussian, sech^2, and parabolic density distribution, and the calculations compared with accurate solutions. The results for the reflection are good at small values of plasma width, but (except for the parabolic case) decrease too rapidly at large plasma widths. The transmission coefficient is more difficult to calculate and, despite the presence of absorption, has a spurious rise to unity at large plasma widths. A Wentzel—Kramers—Brillouin calculation of the transmission yields fairly accurate results and with less labor than required by the perturbation method. (auth)

37709 VIRTUAL PLASMA-WAVE ECHOES. Brackbill, J. U. (Univ. of Wisconsin, Madison). Phys. Fluids; 15: No. 7, 1358-60(Jul 1972).

"Virtual" temporal echoes predicted by the theory of Gould and O'Neil are seen in the results of a numerical simulation of plasma wave echoes by the distribution pushing method and are shown to be observable if the pulse interval and the lifetime of the primary response are comparable. (auth)

37710 NONEQUILIBRIUM ENERGY CONSTANTS ASSOCIATED WITH LARGE-AMPLITUDE ELECTRON WHISTLERS. Davidson, Ronald C. (Univ. of Maryland, College Park); Hammer, David A. Phys. Fluids; 15: No. 7, 1282-4(Jul 1972).

Two independent energy constants are derived for arbitrary-amplitude electron whistler disturbances propagating parallel to a uniform magnetic field B_0. These constants exhibit precisely how energy is partitioned between the fields and the components of plasma kinetic energy perpendicular and parallel to B_0. (auth)

37711 ATTENUATION DUE TO SCATTER IN RANDOM MEDIA. Guthart, H.; Graf, K. A. (Stanford Research Inst., Menlo Park, Calif.). Phys. Fluids; 15: No. 7, 1292-9(Jul 1972).

A summary of calculations is presented to show the merit of a phenomenological model for calculating scatter from a turbulent plasma. The model was applied to two experiments at 9 and 31 GHz, as well as an experiment at 16 GHz. These experiments indicated, in an empirical way, the magnitude of the attenuation coefficient due to scatter. These coefficients were significantly different for the experiments considered. Consequently, a new method for calculating the attenuation due to scatter was outlined and shown to be effective. While this calculation is not rigorous, it does establish a useful relation between plasma parameters and the attenuation coefficient due to scatter. (auth)

37712 STABILITY MECHANISM FOR THE ION-ACOUSTIC WAVES. Krishan, S.; Selim, A. A. (Univ. of Alberta, Edmonton). Phys. Fluids; 15: No. 7, 1319-23(Jul 1972).

The nonlinear frequency shift in the growing ion-acoustic wave and the linear and nonlinear effects associated with the resonance $\omega_q - v \cdot q = 0$ are investigated, and their stabilizing influence is discussed. (auth)

37713 BEAM-GENERATED COLLISIONLESS ION-ACOUSTIC SHOCKS. Sakanaka, P. H. (Columbia Univ., New York). Phys. Fluids; 15: No. 7, 1323-7(Jul 1972).

A numerical study of a one-dimensional collisionless ion-acoustic shock generated by an injection of a plasma beam is presented. The electrons are assumed to be hot and isothermal, and obey the Boltzmann distribution; the ions are described by the Vlasov equation, which is solved by a direct finite-difference scheme. There is a threshold beam velocity, u_{bm}, above which shock is not generated. u_{bm} is a function of the beam-background density ratio and the electron—ion temperature ratio, and is larger than the limit of the ion—ion two-stream instability u_{ts}. For beam velocities ranging from zero to u_{ts}, a shock is observed followed by a region of fully developed two-stream instability. For beam velocities between u_{ts} and u_{bm}, a shock and a phase-space vortex are formed and in between them a quiescent region grows. A stable two-stream remains behind the vortex. (auth)

37714 NONLINEAR INTERACTION OF PLASMA WAVES IN A COLD MAGNETIZED PLASMA. Chin, Yuan-Chung (Univ. of Maryland, College Park). Planet. Space Sci.; 20: No. 5, 711-20(May 1972).

The general coupling equation for the wave–wave scattering in a cold magnetized plasma is derived. The transformation of electrostatic waves is studied specifically in connection with solar Type-III radiation. The relevant numerical analysis is presented. (auth)

37715 PROPAGATION OF ELECTROMAGNETIC WAVES IN AN INDEFINITE CIRCULAR CYLINDRICAL PLASMA COLUMN IN THE ABSENCE OF COLLISIONS. Vacca, Jacopa. Atti Accad. Sci. Torino, I. Cl. Sci. Fis., Mat. Natur.; 106: No. 1, 99-111(Jan–Feb 1972). (In Italian).

The propagation of an electromagnetic wave in a cylindrical plasma column of ions and electrons exposed to an axially uniform magnetic field was studied, neglecting collisions between particles. Waves propagated in the direction of the cylinder axis were considered. The dispersion equations were studied and were examined particularly in the case of absence of an applied magnetic field. (tr-auth)

37716 WAVE GENERATED BY A LOCAL PERTURBATION IN A PLASMA EXPOSED TO A MAGNETIC FIELD. Ignat, Margareta. Atti Accad. Sci. Torino, I. Cl. Sci. Fis., Mat. Natur.; 106: No. 1, 69-82(Jan–Feb 1972). (In Italian).

A wave process generated by a source or a local perturbation in a plasma, initially in a homogeneous state and at rest, and then exposed to a magnetic field is studied. The ions are assumed as Fermi ions and the effect of the electron–ion collisions is neglected. The action of the electrons in thermal motion is considered equivalent to a pressure that depends on the variation of the electron density. (tr-auth)

37717 EXCITATION OF ELECTROSTATIC ION-CYCLOTRON OSCILLATIONS BY A TRANSVERSE CURRENT. Ivanov, A. A.; Murav'ev, B. F. (Moscow Physical-Technical Inst.). Dokl. Akad. Nauk SSSR; 201: No. 3, 567-9(21 Nov 1971). (In Russian).

In connection with the turbulent heating of plasma with the aid of ion-cyclotron oscillations in tokamak-type installations, the excitation of such oscillations by a transverse current was investigated. It was found that the excitation of oscillations under these conditions requires a current velocity substantially smaller than the thermal velocity of the ions. (K.S.W.)

37718 PENETRATION OF WAVES INTO SEMI-INFINITE COLLISIONAL PLASMAS. Khandpur, G. K. (Agrawal Coll., Jaipur, India); Varma, N. L. Z. Phys.; 252: No. 1, 39-50 (1972).

Penetration of longitudinal and transverse fields into a semi-infinite collisional plasma with fractionally accommodating boundary, having specular and diffuse reflections, is studied. The longitudinal-field penetration, studied by Landau and recently by Mason, was extended for transverse waves by Gupta and Varma. The theory is extended for collisions between electrons and ions according to the BGK model, and its resemblance to metals for electrons and holes gives its practical significance. The reflection coefficients and surface impedance are observed. The results are compared with noncollisional cases, and it is observed that depth of penetration for collisional plasma decreases. (auth)

37719 SPATIAL ANISOTROPY OF THE LONGWAVE BRANCH OF ION SOUND IN A CURRENT-CARRYING TURBULENT PLASMA. Ivanov, A. A.; Perepelkin, N. F.; Starykh, V. V.; Fanchenko, S. D. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 62: No. 4, 1362-8(Apr 1972). (In Russian).

The low-frequency spectral range of plasma ion-acoustic oscillations ($\Omega \ll \omega_\pi$) is investigated under conditions of turbulent heating of the plasma by a current in a closed system. A technique for observing incoherent scattering of electromagnetic waves with $\lambda_0 = 8$, 4, and 2 mm by the plasma oscillations is described. It is found that the spectrum of the frequencies observed, Ω, is much narrower than the pass band of the receiver. It is suggested that this may be due to anisotropy of the angular distribution of longwave ion-acoustic oscillations. An expression for the aperture angle θ_{s0} of the anisotropy cone is obtained. Under these conditions it is about 20°. As in a previous investigation, a lag period is observed between the time of application of the electric field producing turbulent heating and the time of appearance of the low-frequency ion-acoustic oscillations. A general law for development of the spectrum $\Omega(t)$ is determined. It is suggested that it is related to a redistribution of energy in the spectrum involving a decrease in the low-frequency range due to induced scattering of ion-acoustic oscillations ω_π by ions. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 36388, 36679, 36904, 36905, and 37452.

37720 (BMBW-FBK-71-2) TABULATED VALUES OF SPATIAL, DIRECTIONAL, AND ENERGY DISTRIBUTIONS OF MULTIPLE SCATTERED GAMMA RADIATION. Stehfest, H. (Frankfurt Univ. (West Germany). Institut fuer Angewandte Physik). Dec 1971. 87p. (In German). Dep. NTIS (U. S. Sales Only).

With a new Monte Carlo technique, which was described in the report BMBW-FB K 71-02, the distribution of multiple scattered gamma quanta as to their location, their direction, and their energy was calculated. The results of these calculations are reported in the form of tables. Point isotropic, plane perpendicular, and point collimated sources in the scattering media water, iron, tin, and lead were investigated. As source energies, 0.662, 1.25, and 3 MeV were chosen. The distances from the source were 1, 4, 10, and 20 mean free paths of the primary radiation. In all the cases the spectra were computed for both infinite and slab geometry. (auth)

37721 (ORNL-4720) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1971. (Oak Ridge National Lab., Tenn.). Oct 1971. Contract W-7405-eng-26. 156p. Dep. NTIS.

Separate abstracts were prepared on 14 sections of this report. (C.H.)

For abstracts of individual sections see: 36077, 36183, 36377, 36451, 36454, 36640–36642. 36649, 36924, 36925, and 37722–37724.

37722 (ORNL-4720, pp 30-41) THEORETICAL RADIATION PHYSICS. Neufeld, Jacob; Ritchie, R. H.; Anderson, V. E.; (and others) (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

CHARGED PARTICLES—stopping power of matter, Z_1^3 effect in, p. 31-2
—stopping power of matter for, contribution of surface losses to, p. 33-4
ELECTRIC MOMENTS—critical dipole, for binding electrons to rotationally excited dipolar system, p. 35-7
ELECTRONS—slowing-down-cascade spectra in solids, p. 37-8
MATTER—charged particle stopping power of, Z_1^3 effect in, p. 31-2
—charged-particle stopping power of, contribution of surface losses to, p. 33-4
MESONS(π)—dose distribution in water phantom, depth-, p. 40-1
NEUTRONS—dose from 400-MeV, effect of lateral scattering on, p. 30-1
—stopping power, semiclassical estimation of, p. 31
—dose from 400-MeV, effect of lateral scattering on, p. 30-1
PROTONS—dose from 400-MeV, effect of lateral scattering on, p. 30-1
WATER—proton dose in, effect of lateral scattering on 400-MeV, p. 30-1
—neutron dose in, effect of lateral scattering on 400-MeV, p. 30-1
—meson (π^-) depth-dose distribution in, p. 40-1 (M.H.R.)

37723 (ORNL-4720, pp 42-50) INTERACTION OF RADIATION WITH LIQUIDS AND SOLIDS. Arakawa, E. T.; Birkhoff, R. D.; Braundmeier, A. J.; (and others) (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

ALUMINUM—x-ray satellites of L_{23} emission bands of, high-energy, p. 46-7
—electron attenuation lengths in, photo-, p. 48-50
ELECTRONS—attenuation lengths in aluminum, photo-, p. 48-50
INDIUM—optical properties of, by ellipsometry, p. 44-6
MAGNESIUM—x-ray satellites of L_{23} emission bands of, high-energy, p. 46-7
—optical plasmon resonance in, photoelectric manifestation of, p. 50
MAGNESIUM FLUORIDES—x-ray emission spectra of, soft, p. 47-8
MAGNESIUM OXIDES—x-ray emission spectra of, soft, p. 47-8
RUBIDIUM—optical properties of, above 72.100 plasma energy, p. 42-3
SILICON—x-ray satellites of L_{23} emission bands of, high-energy, p. 46-7
SODIUM—x-ray satellites of L_{23} emission bands of, high-energy, p. 46-7
TIN—optical properties of, by ellipsometry, p. 44-6
URANIUM NITRIDES—optical properties of, p. 43-4 (M.H.R.)

37724 (ORNL-4720, pp 51-5) PHYSICS OF TISSUE DAMAGE. Arakawa, E. T.; Birkhoff, R. D.; Emerson, L. C.; Hamm, R. N.; Painter, L. R.; Schweinler, H. C.; Sowers, B. L.; Williams, M. R. (Oak Ridge National Lab., Tenn.). Oct 1971.

In Health Physics Division annual progress report for period ending July 31, 1971.

BENZENE—optical absorption of, as function of photon energy, p. 52-4
CARBON TETRACHLORIDE—optical absorption of, as function of photon energy, p. 52-4
CHROMIUM—electron-slowing-down flux in Auger-irradiated, p. 51-3
CYCLOHEXANE—optical absorption of, as function of photon energy, p. 52-4
ELECTRONS—slowing-down in solids, Auger, p. 51-3
GERMANIUM—electron-slowing-down flux in Auger-irradiated, p. 51-3
SILICON—electron-slowing-down spectra in, p. 51-3
ULTRAVIOLET RADIATION—absorption by organic liquids, p. 52-4
WATER—optical absorption of, as function of photon energy, p. 52-4
YTTERBIUM—electron-slowing-down flux in Auger-irradiated, p. 51-3 (M.H.R.)

37725 (ORNL-TM-3758) CALCULATION OF THE ABSORBED DOSE AND DOSE EQUIVALENT FROM NEUTRONS AND PROTONS IN THE ENERGY RANGE FROM 3.5 GeV TO 1.0 TeV. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). May 1970. Contract W-7405-eng-26. 29p. Dep. NTIS.

Nucleon–meson cascade calculations were carried out for monoenergetic neutrons and protons in the energy range from 3.5 GeV to 1.0 TeV normally incident on a semi-infinite slab of tissue 30 cm thick. The absorbed dose and dose equivalent as a function of tissue depth are presented, and analytic expressions for the resulting maximum and average fluence-to-absorbed-dose and fluence-to-dose-equivalent factors are given as a function of incident neutron or proton energy. The calculations were performed by using Monte Carlo methods in conjunction with theoretical nuclear interaction models. (auth)

37726 (SC-DC-721018) K-SHELL COMPTON PROFILES AND INCOHERENT SCATTERING FACTORS. Mendelsohn, Lawrence B. (Polytechnic Inst. of Brooklyn, N. Y. Sandia Labs., Albuquerque, N. Mex.); Biggs, Frank (Sandia Labs., Albuquerque, N. Mex.). [1972]. 37p. (CONF-720404-10). Dep. NTIS.

From International conference on inner shell ionization phenomena; Atlanta, Ga. (17 Apr 1972).

Compton profiles are calculated for K-shell electrons within the Born approximation by use of nonrelativistic "exact" hydrogenic bound-state and continuum wave functions. Impulse approximation profiles are also calculated, and a comparison with the "exact" profiles shows that, as expected, the two lie very close to one another for weak-binding and high-incident photon energies. However, even when these conditions are not fulfilled, the two curves have a tendency to cross one another in the neighborhood of the profile maximum. Thus the integrated profiles (incoherent scattering factors) evaluated in the impulse approximation are extremely accurate over a wide range of incident photon energies, scattering angles, and binding energies. For the case of Mo K_α x rays scattered through 170° for atoms with effective K-shell nuclear charges up to $Z = 20$, impulse incoherent scattering factor calculations are in error by, at most, 15%. These results are much improved over conventional Waller–Hartree incoherent scattering factor calculations, which are found to differ from the "exact" results by 33% for $Z = 10$ up to about 400% for $Z = 20$ for the above case. It is also demonstrated that one cannot accurately describe K-shell Compton cross sections with an incoherent scattering factor that is a function of $\sin \theta/\lambda$ only, as is prescribed in Waller–Hartree theory. It is noted that L-shell exact and impulse hydrogenic Compton scattering profiles exhibit the same type of behavior as those for K-shell electrons. A frequently quoted result of F. Bloch (1934) that the center of the Compton profile is always shifted to higher energies (as compared to the energy of an outgoing photon scattered from a free electron at rest) is demonstrated by analysis of the "exact" profile to be invalid. A constant in Bloch's energy defect result is corrected and the limitations of the result are discussed. This may have bearing on the Co-60 x-ray scattering by the K-electrons of lead where there is disagreement in the location of the profile center. (auth)

37727 (UCRL-51188) LINEAR POLARIZATION OF LOW-ENERGY BREMSSTRAHLUNG. Kuckuck, Robert W. (California Univ., Livermore. Lawrence Livermore Lab.). 15 Feb 1972. Contract W-7405-eng-48. 122p. Dep. NTIS.
Thesis.

The linear polarization of low-energy electron bremsstrahlung from thin targets ($\leq$50 μg/cm^2) of Al, Cu, Ag, and Au was measured for incident electron energies of 50, 75, and 100 keV. The polarization was measured as a function of photon energy at four emission angles (θ = 22.5°, 45°, 90°, and 135°), using a Compton polarimeter with large asymmetry ratio (35 to 150) and a high-resolution Ge(Li) spectrometer (550 eV fwhm for 60-keV photons). A brief discussion of the theoretical aspects of bremsstrahlung polarization, as well as a summary of calculational experimental work to date, is presented. The Compton polarimeter is discussed in detail. The polarization data obtained here are compared with the predictions of various theories and, in particular, with the exact numerical bremsstrahlung calculation of Tseng and Pratt. (auth)

37728 BREMSSTRAHLUNG CROSS-SECTION MEASUREMENTS AT THE SHORT-WAVELENGTH LIMIT. Starek, B.; Aiginger, H.; Unfried, E. (Oesterreichische Hochschule, Vienna). Phys. Lett.; 39A: No. 2, 151-2(24 Apr 1972).

Very precise (±2 – 3%) measurements of the electron-bremsstrahlung cross sections $d^2\sigma/dkd\Omega_k$ at the short-wavelength limit for an incident electron energy of 1.84 MeV and targets of Li, Al, Cu, Ag, Au, and Pb show that the theoretical results of Elwert–Haug, Scherzer, and Sauter–Fano do not agree with the experiment. (auth)

37729 INTERPRETATION OF EXPERIMENTS ON RESONANCE SCATTERING OF γ QUANTA USING CRYSTALLINE SOURCES. Akkerman, A. F.; Myaken'kaya, G. S. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 7, 78-82(1971). (In Russian).

The yield of resonance γ quanta from a monocrystal was calculated with a Vin'yarda model, using a Born–Mayer potential with constants fixed by the lattice characteristics. The results were in excellent agreement with experimental data. The anisotropy of the yield was found as a function of the orientation of the initial momentum relative to the fundamental crystallographic directions. The importance of allowing for many-particle interaction in atomic recoil during its motion in a crystal was demonstrated. (tr-auth)

37730 ENERGY TRANSFER TO ELECTRONS IN FAST PROTON COLLISIONS. Toburen, L. H.; Glass, W. A. (Battelle-Northwest, Richland, Wash.). Contract AT(45-1)-1830. Radiat. Res.; 50: No. 1, 6-19(Apr 1972).

Energy and angular distributions for secondary electrons ejected from several target gases by protons with energies from 300 to 2000 keV were measured. The cross section for energy transfer in primary proton interactions was deduced from the measured electron ejection cross sections. Distributions of kinetic energy transferred to electrons ejected from representative low-atomic-number targets are presented, and effects on these distributions resulting from changes in incident proton energy and atomic number of the target are described. Comparisons are made of measured and calculated cross sections to show the degree of applicability of current theory. (auth)

37731 CHARGE DEPOSITION FROM HIGH ENERGY ELECTRON BEAMS. VanDyk, J.; MacDonald, J. C. F. (Victoria Hospital, London, Ont.). Radiat. Res.; 50: No. 1, 20-32(Apr 1972).

The distributions of charge produced in water during irradiation with nearly monoenergetic electron beams of energies 10 to 32 MeV are described. The homogeneous charge detector employed is of simple design and provides a means of measuring the number of electrons coming to rest at any point in the medium. The values of significant parameters derived from the experimental data are compared with those from the theoretical studies of others, and a qualitative explanation of the differences is given. (auth)

37732 SOME INTEGRAL RELATIONSHIPS IN RADIATION TRANSFER THEORY. Maslennikov, M. V. (Inst. of Applied Mathematics, Moscow). Dokl. Akad. Nauk SSSR; 195: 1062-4 (11 Dec 1970). (In Russian).

Integral formulas were derived, which establish new relations between various solutions for Milne problems. (R.V.J.)

37733 THERMALIZATION DISTANCE DISTRIBUTION OF SECONDARY ELECTRONS. Tachiya, Masanori (Tokyo Univ.). J. Chem. Phys.; 56: No. 9, 4377-81(1 May 1972).

Ionic processes in irradiated substances are considered in terms of the thermalization distance distribution of secondary electrons. Based upon this consideration the thermalization distance distribution function is calculated from experimental data on these processes. Agreement between the distribution functions calculated from the temperature dependence of the free ion yield and from the scavenger concentration dependence of the geminate recombination yield is not good. (auth)

Radiation Protection Standards

37734 QUALITY FACTOR AND DOSE EQUIVALENT IN RADIATION PROTECTION. Boag, J. W.; Burlin, T. E.; Collinson, E.; (and others). Brit. J. Radiol.; 45: No. 532, 314-15(Apr 1972).

It is suggested that the quality factor, Q (postulated in ICRU Report 11, 1968 and 19, 1971) be defined as the factor by which an absorbed dose of radiation of a particular quality must be multiplied in order to derive the corresponding absorbed dose of radiation of standard quality, which would entail as great a risk of biological harm. Radiation of standard quality is defined ideally as radiation giving tL in water of 3.5 keV/μm, where L represents changes in the linear energy transfer. Relationships with RBE are discussed. It is subsequently suggested that dose equivalent H, be defined as the absorbed dose of radiation of standard quality delivered uniformly in space and time which would entail as great a risk of biological harm as the absorbed dose of the particular radiation concerned. Allowance is made for the type of radiation by Q, and for irradiation conditions such as distributions in space and time by nondimensional modifying factors whose product is N. The terms are linked by the relationship H = DQN, where D is the given absorbed dose. (U.K.)

Radiation Source Calibration and Standardization

Refer also to abstracts 36377, 37471, and 37798.

37735 (RISO-256, pp 113-27) RELEVANCE OF ABSORBED-DOSE STANDARDIZATION AND INTERNATIONAL DOSE INTERCOMPARISONS WITH RESPECT TO THE USE OF PULSED ELECTRON ACCELERATORS. Holm, Niels W. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.
In Aspects of research at Risoe.

The increasing use of high-energy photon and electron sources in radiation therapy and in radiation processing has caused the international and national standards laboratories to devote much effort to providing for absorbed-dose standardization services for these sources. This paper draws attention to the serious influence on the radiation effect of a given absorbed dose at the extreme dose rates obtained from pulsed electron accelerators and suggests alternative means of standardization. (auth)

37736 MEASUREMENT OF OER AND RBE OF A 910 MeV HELIUM ION BEAM, USING CULTURED CELLS (T-1). Raju, Mudundi R.; Gnanapurani, Madhvanath; Martins, Bambino; Howard, Jerry; Lyman, John T. (Univ. of California, Berkeley). Radiology; 102: No. 2, 425-8(Feb 1972).

The depth-dose distribution of a 910-MeV monoenergetic helium ion beam was modified by using a ridge filter in the beam path, making the region of maximum dose uniform over a distance of about 6 cm of water. Studies of the relative biological effectiveness (RBE) and oxygen enhancement ratio (OER) using human kidney cells (T-1) indicated that the RBE at the broad peak region was about 1.3 to 1.4, compared with that at the beam entrance. The OER was reduced to about 1.7 to 1.9. (auth)

Shielding Calculations and Theory

37737 (EUR-4744) ALBEDO TECHNIQUES FOR CALCULATING THE RADIATION TRANSPORT THROUGH VOIDS. Chinaglia, B. (European Atomic Energy Community. FIAT, Turin (Italy). Sezione Energia Nucleare. Ansaldo S.p.A., Genoa (Italy)). Mar 1972. 60p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 85.-.

The problem of neutron transport through voids was solved by means of a calculation technique based on the albedo concept.

Simple criteria for the determination of the albedo and of the initial current of particles emerging from the medium into the void for the first time were established. The method assumes that the initial current has two components: removal with straight line propagation, and diffusion with a P1 angular distribution at the medium void interface. The mathematical solution of the integral equation giving the reflected current was developed for some geometries of interest in practical cases: cylindrical ducts with or without reflecting ends, and annular gap between two concentric cylindrical surfaces. Experimental tests on ducts in water media have shown that the space and energy distribution of the neutron flux may be adequately described with few neutron groups, and the maximum absolute error was below a factor 2 for an attenuation of the order of 10^{-4}. (auth)

37738 (HEDL-TME-71-184) FTR SET 300-S, MULTIGROUP CROSS SECTIONS FOR FTR SHIELDING CALCULATIONS. Kidman, R. B.; Schenter, R. E. (Hanford Engineering Development Lab., Richland, Wash.). Dec 1971. Contract AT(45-1)-2170. 125p. Dep. NTIS.

A preliminary 42-group shielding cross section library consisting of 53 different isotopes is presented. The multigroup constants were originally generated by ETOX (a code which calculates group constants for nuclear reactor calculations) using the Evaluated Nuclear Data File, ENDF/B Version II, and the Battelle Master Library for the fundamental nuclear data input. Many of the isotopes important to fast reactor physics calculations have been altered in the top 25 groups to achieve better agreement with integral results. (auth)

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts 36148, 36625, and 36906.

37739 (CEA-R-4301) STUDY OF POINT DEFECTS CREATED BY ELECTRON IRRADIATION IN MOLYBDENUM. Bichon, Pierre (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr 1972. 70p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The spectrum of resistivity recovery is studied by isochronal thermal treatment from 20°K to 550°K. Stage I is decomposed into four substages: I_B (27°K), I_C (33°K), I_D (42°K), and I_E (55°K). Stage III shows a fine structure on the high-temperature side which had never been observed. By isothermal experiments, it was observed that annihilation processes of I substages have an order 1, and stage III obeys to a kinetic or order 2; that is confirmed by dose effect. The energy of defects I_B (0,088 eV) and I_D (0,122 eV) is determined. The association of resistivity experiments with the internal friction study done simultaneously by R. PICHON allows proposal of an interpretation model Stage I_D is related to the annihilation of a correlated molybdenum interstitial which is recombined with its own vacancy. Stage III is associated with the vacancy defect migration to trapped mono-interstitials. (auth)

37740 (CEA-R-4321) THERMOELECTRIC PROPERTIES OF STABLE AND ENRICHED OXIDES OF NATURAL U IN AND OUTSIDE THE NEUTRON FLUX. Sorriaux, Andre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1972. 159p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ. (France).

Natural and 5% ^{235}U-enriched UO_2 and U_3O_8 were studied. The experiments were carried out in a 20 to 1200°C interval in an argon atmosphere. The experiments performed outside the neutron flux consisted of measuring the electrical conductivity and the thermoelectric power as a function of temperature. The results obtained demonstrate that slightly superstoichiometric U dioxides (U/O approximately equal to 2.001), which may be natural or enriched, and sintered or monocrystalline, behave as p-type semiconductors obeying classical theory, the acceptor levels being situated 0.35 eV away from the valence band; the width of the forbidden band was evaluated to be 1.8 eV. Sintered, natural or enriched, U_3O_8 oxides, although slightly substoichiometric (O/U approximately 2.65) are also p-type semiconductors, the acceptor levels being very close to the valence band (less than 0.03 eV of this value being the limit of the experimental accuracy). The width of the forbidden band is 0.48 eV. The quality factor of the uranium dioxide is small compared with the more usual materials: $Z = 1.5 \times 10^{-6}(°K)^{-1}$ at 1200°K. This result is confirmed for tests under neutron flux. (auth)

37741 HIGH RESOLUTION REPLICAS FOR ELECTRON MICROSCOPE OBSERVATION AND APPLICATION TO ION DAMAGE IN SILICON. Vitali, G. (Univ., Rome). Rev. Sci. Instrum.; 43: No. 6, 911-14(Jun 1972).

A high-resolution replica technique for observation with the electron microscope was developed by applying suitable forces during the replica process. The method used allowed the resolution of surface damage structures having dimensions of the order of 40 to 50 Å, as produced in In-implanted Si samples. (auth)

37742 INTERACTION BETWEEN SIMPLE LATTICE DEFECTS AND DONOR IMPURITY ATOMS IN GERMANIUM. Tkachev, V. D.; Urenev, V. I. (Belorussian State Univ., Minsk). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 8, 1324-9(Feb 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 8, 1516-22 (Aug 1971).

The energy-level spectrum, formation kinetics, and thermal stability of radiation defects in antimony-doped n-type germanium after ^{60}Co γ irradiation at 300°K are discussed. It is shown that vacancy–antimony (SbV) and divacancy–antimony (SbVV) complexes are formed during irradiation and that the levels $E_c - 0.21$, $E_v + 0.21$ eV, and $E_c - 0.16$, $E_v + 0.16$ eV, respectively, belong to these complexes. The initial decrease in the electron density in the conduction band in "oxygen-free" crystals is caused by the formation of SbV complexes. Annealing of the radiation defects at 160°C is accompanied by the dissociation of SbV and the formation of SbVV complexes, themselves annealed at 240 to 260°C. For high γ-radiation fluxes, the limiting position of the Fermi level is determined by the concentration ratio of the levels $E_c - 0.32$ and $E_v - 0.30$ eV. It is suggested that these levels belong to complex radiation defects containing atoms of an accidental impurity, whose concentration may exceed that of the initial donors. (auth)

37743 INFLUENCE OF OXYGEN ON THE FORMATION OF RADIATION DEFECTS IN GERMANIUM. Tkachev, V. D.; Urenev, V. I. (Belorussian State Univ., Minsk). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 8, 1416-18(Feb 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 8, 1622-4(Aug 1971).

A Hall-coefficient and a photoconductivity study was made of Sb-doped n-type Ge enriched with oxygen and irradiated with ^{60}Co γ rays. The $E_c - 0.21$ eV level (SbV complex) and the number of removed electrons were studied as functions of dose. The results show that O_2 reduces the rate of introduction of the SbV complexes, and that electrically active complexes with levels at $E_c - 0.32$ eV and $E_v + 0.30$ eV are produced. (D.L.C.)

37744 THRESHOLD ENERGY FOR THE FORMATION OF RADIATION DEFECTS IN SEMICONDUCTORS. Gerasimenko, N. N.; Dvurechenskii, A. V.; Panov, V. I.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 8, 1439-41(Feb 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 8, 1644-6(Aug 1971).

EPR measurements were carried out at 77°K on A centers in n-type Si crystals ($2 \Omega \cdot cm$, 2×10^{17} O_2/cm^3) after electron irradiation. The effects of electron energy and current density on the rate of introduction of A centers were studied, and the threshold energy was determined to be 125 ± 20 keV. Extrapolation from high energies yielded incorrect values which depend strongly on the nonequilibrium carrier lifetime. (D.L.C.)

37745 CAPTURE OF HOT CARRIERS BY MULTIPLY CHARGED RADIATION DEFECTS IN GERMANIUM. Latyshev, A. V.; Stel'makh, V. F.; Tkachev, V. D. (Belorussian State Univ., Minsk). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 8, 1446-8(Feb 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 8, 1650-3(Aug 1971).

Germanium crystals doped with antimony were irradiated with fast-neutrons, and the current–voltage characteristics and Hall effect were measured before and after annealing. The following energy levels were found from the annealing: $E_v + 0.16$, $E_v + 0.20$, $E_v + 0.30$, $E_c - 0.32$, $E_c - 0.21$, and $E_c - 0.16$ eV. The defects were annealed in two stages, at 120 to 150°C and 260 to 300°C. The results indicate that the multiply charged radiation defects capable of capturing hot electrons may be neutral, singly charged, or doubly charged. (D.L.C.)

37746 ANNEALING OF GALLIUM ARSENIDE DOPED BY IMPLANTATION OF GROUP VI IONS. Zelevinskaya, V. M.; Kachurin, G. A. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 8, 1455-6(Feb 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 8, 1659-60 (Aug 1971).

The effect of isochronous annealing on the electric conductivity and Hall emf of p-type GaAs implanted with 30-keV S, Se, and Te ions was studied. The annealing behavior of the low-resistivity layers and the carrier density are compared with those for Group II and IV elements. The effects of carrying out the ion implantation at room temperature or 300°C were studied. Explanations of the results are offered. (D.L.C.)

37747 EFFECT OF NEUTRON IRRADIATION ON DIFFUSION OF ZINC IN INDIUM ARSENIDE AND GALLIUM ARSENIDE. Savin, E. P.; Boltaks, B. I. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 7, 1173-6(Jan 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 7, 1331-4(Jul 1971).

The effect of fast neutrons on the diffusion of zinc in InAs and GaAs was investigated. It was found that at low diffusion temperatures (600 to 650°C), when the zinc concentration is low and zinc migrates mainly along vacancies, an increase in the vacancy concentration on irradiation causes an increase in the diffusion coefficient. At high temperatures and correspondingly higher zinc concentrations, when the diffusion mechanism becomes more complex (dissociative) and vacancies formed by irradiation act as "traps" for diffusing Zn atoms, irradiation causes a reduction in the effective diffusion coefficient. On the other hand, since most of the zinc dissolved in the semiconductor lattice is located at the vacancies, an increase in the vacancy concentration on irradiation increases the solubility of Zn. (auth)

37748 SPECTRUM OF LOCAL LEVELS IN CADMIUM SELENIDE IRRADIATED WITH γ QUANTA. Ust'yanov, V. I. (Inst. of Nuclear Research, Kiev). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 7, 1205-8(Jan 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 7, 1371-4(Jul 1971).

A study was made of the effect of γ irradiation on the energy positions of shallow levels ($\Delta E = 0.12$, 0.21, and 0.32 eV) in cadmium selenide. It is shown that the increase in the activation energy of these centers is due to a decrease in the static permittivity of the crystal, which occurs on γ irradiation of cadmium selenide. (auth)

37749 RECOMBINATION IN p-TYPE SILICON IRRADIATED WITH FAST ELECTRONS. Gorodetskii, S. M.; Grigor'eva, G. M.; Izmailov, A. A.; (and others) (Inst. of Semiconductors, Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 7, 1280-2(Jan 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 7, 1463-6(Jul 1971).

Recombination was investigated in oxygen-bearing boron-doped p-type Si after irradiation at room temperature with 1-MeV electrons. The dependences of the electron lifetime on temperature (−120 to +140°C) and injection efficiency (0.01 to 0.4) were determined. The results indicate that the energy position of the radioinduced recombination level is $E_v + 0.26 \pm 0.01$ eV, and that the centers are simple donors. (D.L.C.)

37750 VOIDS. Bullough, R.; Lidiard, A. B. (Atomic Energy Research Establishment, Harwell, Eng.). Comments Solid State Phys.; 4: No. 3, 69-77(Mar-Apr 1972).

After a brief introduction to the subject, important recent theoretical and experimental developments are summarized and considered in the context of imperfect solids. The growth of voids and void lattices are among matters discussed. The radiation damage aspect is emphasized. 16 references. (UK)

37751 OPTICAL AND EPR STUDIES ON THE 5 eV BAND OF $CdCl_2$ CRYSTALS. Matsumoto, Hiroaki; Nakamura, Yoshimitsu (Fukui Univ., Japan. Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 50: No. 1, 8-19(Jan 1972).

Optical absorption spectra of various impurity ions doped in $CdCl_2$ crystals are studied to identify the center responsible for the 5-eV absorption band. Electron paramagnetic resonance absorption spectra are also investigated on the γ- or x-irradiated $CdCl_2$ crystals. The crystals can be classified into two groups: (1) $CdCl_2$ containing Li ions and (2) $CdCl_2$ containing other impurities than Li ions. The 5-eV absorption band of group 1 crystals appeared about 0.10 to 0.16 eV lower than that of group 2 crystals. In the crystals of group 1, the 5-eV absorption band disappeared with irradiation at room temperature and paramagnetic centers were produced instead. In the crystals of group 2, irradiation at room temperature did not change the 5-eV absorption band but x-ray irradiation at liquid-nitrogen temperature decreased the intensity of the 5-eV absorption and produced a small new absorption band at 4.55 eV. After the irradiation had ceased, the recovery of the 5-eV absorption and the disappearance of the 4.55 eV band were attained very quickly. Possible models of the center responsible for the 5-eV band and the paramagnetic center are discussed. (auth)

37752 THERMOLUMINESCENCE IN QUARTZ IRRADIATED BY GAMMA RAYS: A MINERALOGICAL AND GEOLOGICAL APPLICATION. Inagaki, Hirotake (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 50: No. 1, 45-50(Jan 1972).

Thermoluminescence was applied to quartz from various geological origins, and the difference of geological occurrences of quartz was detectable from their glow peaks. When irradiated by gamma rays, three kinds of glow peaks (A, B, and C peaks) appeared. The nature of B and C peaks in quartz from various rocks was discussed, mainly the heights and the positions of C peaks after gamma irradiation of 10^7 roentgen were examined. It is shown that the height and position of C peak are closely related to the geological origin. (auth)

37753 RADIATION-DAMAGE-INDUCED APPARENT OPTICAL ABSORPTION INTERPRETED AS SCATTERING FROM DEFECT ZONES. Meek, R. L.; Gibson, W. M.; Maclennan, C. G.; Maher, D. M. (Bell Telephone Labs., Murray Hill, N. J.). Appl. Phys. Lett.; 20: No. 10, 400-3(15 May 1972).

Radiation-induced apparent optical absorption in the wavelength range 0.5 to 2.5 μ of thin silicon crystals, which were irradiated with 1.8-MeV He^+ ions, is interpreted in terms of scattering from defect zones. Fitting the absorption and refractive index data to the predictions of Mie scattering theory allows determination of the average size, number, and refractive index of the defect zones. For 10^{15} to 10^{16} ions cm^{-2} incident on a crystal 2.8-μ thick, this analysis indicated a zone radius of about 2200 Å, a refractive index for the zone of about 1.04 times that of undamaged silicon independent of wavelength, and $\sim 10^{-7}$ zones produced per incident ion. At larger fluence, the zone size increased and the number of zones decreased. Transmission-electron-microscopy observations confirm the presence of defective zones whose geometry, size, and number density are in reasonable agreement with the theoretical predictions. (auth)

37754 EFFECT OF γ-IRRADIATION ON THE CRITICAL RESOLVED SHEAR STRESS OF KCl CRYSTALS. Suszynska, M. (Inst. of Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 2, 107-11(Mar 1972).

Effects of γ irradiation (^{60}Co source) at a dose rate of about 10^6 rad/h on the critical resolved shear stress of nominally pure KCl crystals were examined. Results showed that in the dose range from 2.5×10^5 up to 1.4×10^8 rads the interaction between dislocations themselves was mostly responsible for the radiation hardening of KCl crystals examined. (auth)

37755 LOW TEMPERATURE ELECTRON RADIATION DAMAGE AND RECOVERY IN CADMIUM. Simon, J. P.; Minier, C. (CEN, Grenoble, France). Radiat. Eff.; 13: No. 1-2, 137-42(Mar 1972).

Cadmium samples were irradiated with 3-MeV electrons at 20°K. The defect production and subsequent recovery up to 20°K were studied by means of electrical resistivity measurements. The results were compared with those obtained earlier by R. R. Coltman (1971) relating to irradiated cadmium with thermal neutrons. The different hypotheses, in order to explain the important stage III, are discussed in the light of the existing experimental data on irradiation defects and quenched defects in cadmium. (auth)

37756 RADIOCHEMICAL REDUCTION OF RARE EARTH IONS AND COLOR CENTERS IN SrF_2 SINGLE CRYSTALS. Shul'gin, B. V.; Gavrilov, F. F.; Zyryanov, A. P.; (and others) (Ural Polytechnic Inst., Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1777-80(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 1997-2000(Nov 1971).

The effects of reactor radiation on single crystals of SrF_2 + rare earth ions led to radiochemical reduction of the rare earth ions (rare earth^{3+} ions → rare earth^{2+} ions) and formation of color centers. The radiochemical reduction efficiency was greater for neutron bombardment than for gamma irradiation. The presence of terbium sharply increased the reduction of Dy^{3+} ions. For specimens of SrF_2 + rare earth ions, irradiated in the reactor, the absorption bands in the UV region of the spectrum were independent of the type of activator and may be due to lattice defects. The color centers formed in SrF_2 + rare earth ions by the effects of reactor irradiation were very stable. (auth)

37757 EFFECT OF GAMMA IRRADIATION ON ELECTRIC PROPERTIES OF POLYETHYLENE. Kim, Young Jun New Phys. (S. Korea); 11: No. 3, 115-27(Sep 1971). (In Korean).

A study was made of the electric conductivity and its dependences on dose rate and temperature, the decrease of induced current, and the temperature characteristics of volume resistivity in 1-mm and 0.5-mm thick, low-density polyethylene specimens, using ^{60}Co gamma rays (600 and 26 Ci) between 150 and −130°C. The effects of gamma rays on the electric properties of polyethylene during and after its irradiation are as follows: (1) If the dependence on dose rate during irradiation is represented by $i \propto R^{\Delta}$, where i is induced current and R is dose rate, the values of Δ, between 2×10^3 and 3×10^4 rad/hr were 0.66 at 15°C and 0.72 at −12°C, which are smaller than Fowler's 0.81. As for the dependence on dose rate after irradiation, when the same absorbed dose from 17 to 48 Mrad was given in the atmosphere, to the specimens that had been preirradiated with 3.60×10^3, 1.74×10^4, and 1.39×10^5 rad/hr, respectively, its effect was in proportion to the irradiation period, owing to the secondary reaction of oxygen. (2) The dependence on temperature during irradiation showed its transition point at about −30°C when the dose rate was 5.7×10^4 rad/hr, and it increased exponentially ($i \propto \exp(-E/KT)$) above −30°C. The stimulated current under irradiation reached its peak between −40 and −110°C. As for the characteristics of $\log \rho - 1/T$ after irradiation, a jumping phenomenon was observed near the melting point. (3) The charge carriers are considered to be electrons, since the current drops sharply after cessation of gamma irradiation and the graph of current drop shows the form of an exponential function. (auth)

37758 ELECTRON TRAPPING IN NEUTRON-IRRADIATED SILICON STUDIED BY SPACE-CHARGE-LIMITED CURRENT.

Vu Thuong Quat (Minh-Duc Univ., Saigon, South Vietnam); Nicolet, Marc-A. J. Appl. Phys.; 43: No. 6, 2755-62(Jun 1972).

The trapping and detrapping of electrons is studied through measurements of space-charge-limited current in the temperature range $77 \leq T \leq 293°K$ in high-purity silicon after irradiation with 14-MeV neutrons at a dose of about 1.2×10^{11} neutrons/cm^2. A model is developed, which describes most of the results quantitatively and self-consistently, including dc characteristics. Two distinct trap levels exist: The "fast" levels lie at $E_{tf} = 0.14 \pm 0.005$ eV below the conduction band, with a concentration of $N_{tf} \simeq 1.4 \times 10^{12}$ cm^{-3} and a capture cross section of $\sigma_f \simeq 4 \times 10^{-17}$ cm^2 at 77°K. The "slow" levels lie at $E_{ts} = 0.47 \pm 0.01$ eV below the conduction band, with a concentration of $N_{ts} \simeq 1.6 \times 10^{12}$ cm^{-3} and a capture cross section of $\sigma_s \simeq 1.4 \times 10^{-14}$ cm^2 at 293°K. At 77°K, injected free electrons are initially captured by the fast 0.14-eV traps and then sink into the deep 0.47-eV traps, predominantly without being re-emitted into the band. Above approximately 110°K, the detrapping rate from the shallow traps becomes so fast that the deep traps dominate. The results also offer a direct verification of the simple model of space-charge-limited current dominated by shallow and deep traps. Some pertinent unresolved questions are also formulated. (auth)

37759 BEAM EFFICIENCY, INELASTIC SCATTER, AND RADIATION DAMAGE IN THE HIGH-VOLTAGE MICROSCOPE. Parsons, D. F. (Roswell Park Memorial Inst., Buffalo). J. Appl. Phys.; 43: No. 6, 2885-90(Jun 1972).

The composite plasmon-free atom scattering theory of Crick and Misell was used to calculate the angular intensity distribution of inelastic scatter from a model biological object (50 Å of amorphous carbon) at 100- and 1000-kV acceleration voltage. It is shown that in most situations of electron microscope imaging of supramolecular structures the damage associated with viewing and recording of the image is related to the ratio of inelastic/elastic scatter (I/E) or to I/(I + E), and that these ratios are approximately the same at 100 and 1000 kV. It is concluded that there is no intrinsic improvement in beam radiation damage in using higher acceleration voltage (1000 kV). In current use, the radiation damage in the high-voltage microscope is frequently much higher than in a conventional (100 kV) microscope because of the decreased sensitivity of photographic emulsions at 1000 kV. Special emulsions are required for high-voltage biological electron microscopy. (27 references) (auth)

37760 STRUCTURE DEFECTS GENERATED BY A NON-IMPACT MECHANISM IN INDIUM ANTIMONIDE. Vitovskii, N. A.; Vikhlii, G. A.; Ivleva, V. S.; Mashovets, T. V. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 5: No. 10, 1686-9(Apr 1972).

Translated from Fiz. Tekh. Poluprov.; 5: No. 10, 1943-7 (Oct 1971).

Changes in the conductivity of p-type indium antimonide resulting from low-temperature irradiation with x rays or visible light were found to be due to two different processes: charge exchange in the surface oxide film and the formation of structure defects in the bulk of a crystal. The relative contribution of these two processes depended on the energy of the incident radiation quanta and on the state of the surface. The kinetics of both processes was investigated and the temperature dependences of the hold density in the irradiated samples were obtained. (auth)

37761 CHANGE OF LATTICE CONSTANT ON X-RAY IRRADIATION OF AN IMPURE SINGLE CRYSTAL OF LITHIUM FLUORIDE. Golubeva, L. A.; Moshkova, E. V.; Shishelov, A. A. (Leningrad Polytechnic Inst.). Sov. Phys.-Solid State (Engl. Transl.); 13: No. 11, 2887-9(May 1972).

Translated from Fiz. Tverd. Tela; 13: No. 11, 3428-30(Nov 1971).

The influence of x-ray irradiation on the change of lattice constant of lithium fluoride single crystals grown in air with various concentrations of magnesium as an impurity was studied, as well as lithium fluoride single crystals grown in a vacuum and not containing any specially added impurity. Results show that with increase of the magnesium impurity concentration the relative change in the lattice constant becomes larger. Variation in the concentration of uncontrollable impurities in the raw material, and similarly of hydroxyl ions taken up by the crystal during growth, has a marked influence on the change of lattice constant. With decrease of the hydroxyl ion concentration in crystals grown in a vacuum, the change in lattice constant decreases. (D.H.M.)

37762 ENERGY LOSS DISTRIBUTION OF ELECTRONS FROM ^{204}Tl ABSORBED IN SILICON. Sawicka, Barbara (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 16: No. 7-8, 311-23(1971).

On the basis of Spencer's theory and tabulated data the function, J(x), of the electron energy-loss distribution in silicon for the case of monoenergetic electrons emitted from a plane source and incident perpendicularly on the detector surface was calculated. The electron energy: 0.025, 0.5, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.765 and 1.0 MeV was taken into account. These calculations were a basis for the determination of energy absorbed distribution in plane layers at the z distance from the surface silicon of the absorbent for the continuous spectrum of electrons emitted from ^{204}Tl. Using silicon surface-barrier detectors, the measurements of electron energy loss emitted from ^{204}Tl in silicon layers within the thickness range of 57 to 658 μm were made. The results obtained were compared with the calculated curve of electron energy loss from ^{204}Tl in the silicon layers at various thicknesses. A good agreement of experimental results with the theoretical data was obtained. These results will be used as a basis to the determination of absorbed dose rate from electrons for various thicknesses of absorbent by means of the silicon beta-ray dosimeter. (auth)

37763 ELECTRON DEPTH–DOSE DISTRIBUTION MEASUREMENTS IN FINITE POLYSTYRENE SLABS. Rosenstein, Marvin; Eisen, Harvey; Silverman, Joseph (Univ. of Maryland, College Park). J. Appl. Phys.; 43: No. 7, 3191-3202(Jul 1972).

Experimental depth-dose curves for 2.00-MeV electrons incident on layers of polystyrene were obtained for broad-beam geometry as a function of slab thickness and incident beam angle. Calibrated radiochromic dye films were used as dosimeters. Continuous spatial absorbance changes in the irradiated film were recorded with the aid of a scanning densitometer. Data were obtained for the following conditions: (a) polystyrene thicknesses 0.42, 0.63, and 1.5 times the electron range, and (b) electron-beam incidence angles of 0, 15, 30, 45, 60, and 75° to the normal. Comparisons were made with theoretical depth-dose histograms generated by the Monte Carlo computer code ETRAN. Close agreement was found for the two thicker slabs, but energy absorption in the thin slab was observed to be lower than that predicted by the calculations by 5 to 15%. (auth)

37764 RADIATION STUDIES AT THE NUCLEAR REACTOR AT SALASPILS. Shvarts, K. K. Latv. PSR Zinat. Akad. Vestis; No. 2, 6-9(1972). (In Russian).

The reactor of the Institute of Physics (Latvian SSR) has been in operation since 1961. Current work at the reactor includes radiation physics of solid materials (ionic crystals and ferrites), and nuclear physics (nuclear spectroscopy and activation analysis, and criticality measurements). Radiation corrosion, radiation effects on wood and growing plants, and mutagenicity studies are also in progress. (K.S.W.)

37765 X-RAY EXAMINATIONS OF SILICON MONOCRYSTALS BOMBARDED WITH IONS. Dressler, L. (Friedrich-Schiller Univ., Jena, Ger.). Phys. Status Solidi (a); 11: No. 1, K65-7(16 May 1972).

The bombarded silicon single crystals were examined by x-ray diffraction in transmission. From visibilities of the moiré fringes in the CuK_α and CoK_α (111) topographs the bombardment with 1.28-MeV H_2^+ ions resulted in a t_1-value (the thickness of the covering layer of the "bicrystals") of (8.4 ± 0.8) μm. (D.H.M.)

Physical Properties

Refer also to abstracts 36502, 36505, 36511, 36518, 36603, 36634, and 37387.

37766 (BNL–16679(Pt. 1 and 2)) BAND THEORIES OF FERROMAGNETISM. Watson, R. E. (Brookhaven National Lab., Upton, N. Y.). [1972]. 95p. Dep. NTIS.

Lecture notes are presented on the magnetic properties of transition metals. Topics covered include: Hartree–Fock theory, criteria for magnetically ordered metals and their magnetic moments and spiral structures, spin waves in ferromagnetic metals, photo and field emission experiments on Ni, and transition-metal alloys. In Part II, the Coulomb repulsion term, paramagnetic moments, and interatomic exchange are considered. (54 figures) (D.L.C.)

37767 (RISO–256, pp 223-32) MECHANISMS OF MAGNETIC ANISOTROPY IN TERBIUM. Moeller, H. Bjerrum; Houmann, J. C. G.; Jensen, J.; Lindgard, P.-A.; Nielsen, M.; Mackintosh, A. R. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.

In Aspects of research at Risoe.

The magnetic field dependence of the magnon energies in Tb has been studied by inelastic neutron scattering. From the results at q = 0, it was confirmed that the frozen-lattice model is applicable, and the single-ion anisotropy parameters and their temperature dependences were deduced. Measurements in the c-direction at finite q revealed that the two-ion coupling between the moments is highly anisotropic. (auth)

37768 PHOTON APPEARANCE POTENTIAL SPECTROSCOPY OF THORIUM. Redhead, P. A.; Richardson, G. W. (National Research Council, Ottawa). J. Appl. Phys.; 43: No. 7, 2970-2(Jul 1972).

Evaporated films of thorium on a tungsten substrate were examined by photon appearance potential spectroscopy (PAPS) with incident electron energies in the range 80 to 1000 eV (O_5 to N_3 levels). For low coverage, the peaks corresponding to the O_5, O_4 and N_7, N_6 levels were immediately observed. As coverage was increased, these peaks increased slightly and the other O and N peaks appeared suddenly; the N_3 was the last to appear. Peak shape and position were independent of coverage. After exposure to oxygen, the major peaks were not significantly shifted but new satellites of the O_4, N_7, and N_6 peaks were observed. (auth)

37769 MAGNETIC CHARACTERISTICS OF SOME BINARY AND TERNARY 2–17 COMPOUNDS. Schaller, H. J.; Craig, R. S.; Wallace, W. E. (Univ. of Pittsburgh). J. Appl. Phys.; 43: No. 7, 3161-5(Jul 1972).

The magnetic anisotropy of R_2Co_{17} and $R_2Co_{17-x}T_x$ compounds with R = Y, Ce, Pr, Nd, Th and T = Mn, Fe was investigated. The directions of easy magnetization were determined by x-ray studies on oriented powders. The several R_2Co_{17} compounds, except for Ce_2Co_{17}, have an easy basal plane; the behavior of Ce_2Co_{17} could not be clarified. Replacement of Co by Mn or Fe changes the easy magnetization direction from the basal plane to the c axis. Anisotropy fields were measured on magnetically aligned powders. The values for the anisotropy fields range between 12 and 24 kOe. Curie temperatures and saturation magnetization data for $R_2Co_{17-x}T_x$ compounds with T = Mn, Ru and R = Ho, Y are reported. The decrease of the magnetization with increasing x observed in the system $Y_2Co_{17-x}T_x$ is accounted for by assuming either a reduced Co moment or an antiparallel coupling of the T transition-metal spin. Similar considerations hold for $Ho_2Co_{17-x}T_x$ ternaries. (auth)

37770 POSITRON–VACANCY INTERACTION IN ALUMINUM. McKee, B. T. A.; Jost, A. G. D.; MacKenzie, I. K. (Dalhousie Univ., Halifax, N. S.). Can. J. Phys.; 50: No. 5, 415-20(1 Mar 1972).

Precision measurements of positron lifetimes in aluminum at 42 temperatures are presented. The data are analyzed in a manner consistent with both trapping and nontrapping models of positron–vacancy interaction. Both models can be characterized by two parameters, the vacancy formation energy and a trapping or enhancement parameter. The two-component trapping model seems to be favored by the data, but a one-component interpretation is possible. The values obtained for the vacancy formation energy in aluminum are 0.71 eV according to the trapping model and 0.78 eV according to the nontrapping model. (auth)

37771 ELECTRON SPIN RESONANCE OF Eu^{2+} IN Ca AND Yb METAL. Schmidt, H. K. (Technische Hochschule, Darmstadt, Ger.). Z. Naturforsch.; 27a: No. 2, 191-7(Feb 1972).

ESR measurements of Eu^{2+} (concentration $\leq 1\%$) in Ca and Yb metals in the temperature range from 5 to 30°K at microwave frequencies of 35 and 9.6 GHz are reported. In Ca a "bottleneck" was observed, whereas in Yb the resonance condition is determined by the "dynamical effect." By adding Ca impurities to Yb, the influence of the dynamical effect was lowered. The measurements can be adequately described by the formulas of Hasegawa, yielding an exchange integral for Eu^{2+} in Yb of $J = +0.09$ eV. (auth)

37772 PHONON-ASSISTED ENERGY TRANSFER BETWEEN TRIVALENT RARE EARTH IONS. Yamada, Naoto; Shionoya, Shigeo; Kushida, Takashi (Tokyo Univ.). J. Phys. Soc. Jap.; 32: No. 6, 1577-86(Jun 1972).

Nonresonant phonon-assisted energy transfer between trivalent rare earth ions is studied using Y_2O_3 as the host crystal. The transfer probabilities are obtained from the analysis of the decay rates of donor luminescence for various combinations of donor and acceptor ions in which energy gap, i.e. mismatch of energy, is varied in a wide range up to 4000 cm^{-1}. The probabilities are decreased exponentially with the increase of energy gap in agreement with the theory of Miyakawa and Dexter. The observed value of the parameter expressing the exponential dependence agrees with the theoretically estimated value. The temperature dependence of the probabilities presents the direct evidence that the mismatch of energy is compensated by the emission of phonons. It is revealed that the phonon of about 400 cm^{-1} which produces the highest intensity in vibronic sidebands contributes dominantly to the phonon-assisted process. (auth)

37773 MULTIPLE KINK EFFECT IN GRAPHITE. Hayashi, Haruhisa; Yazawa, Kazuhiko (Univ. of Electro-Communications, Tokyo). J. Phys. Soc. Jap.; 32: No. 6, 1545-9(Jun 1972).

It is found that the current–voltage relation of graphite has three kink points under the influence of a transverse magnetic field at 77 and 300°K. This phenomenon, in spite of its appearance at these high temperatures, is identified as Esaki effect, and three kinks are attributed to the interaction between carrier particles and three modes of phonons. In graphite, carriers interact with the transverse mode as well as the longitudinal one unlike in an ordinary nonpolar material. A theoretical analysis yields information on the number of the carriers contributing to each mode. (auth)

37774 DOMAINS IN $SmCo_5$ AT LOW TEMPERATURES. Westendorp, F. F. (Philips Research Labs., Eindhoven, Netherlands). Appl. Phys. Lett.; 20: No. 11, 441-3(1 Jun 1972).

Domain spacing in $SmCo_5$ is observed to increase by a factor of 1.5 at 78°K as compared with the spacing at room temperature. This indicates a difference in domain wall energy, which may explain the experimentally found difference in coercive force. (auth)

37775 MAGNETIC PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEM Sc_2O_3–Ti_2O_3. Perelyaev, V. A.; Bazuev, G. V.; Shveikin, G. P. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1784-6(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2004-6(Nov 1971).

Measurements of the magnetic susceptibility at 77 to 300°K showed that the solid solutions formed in the system $Sc_2O_3-Ti_2O_3$ are paramagnetic. The molar susceptibility of $TiO_{1.5}$ in the specimens obeyed the Curie–Weiss law for compositions containing ≥10 mole % Sc_2O_3. The magnetic moments of the Ti^{3+} ion were close to the purely spin value for the d^1 configuration in solid solutions containing 50 to 80 mole % Sc_2O_3, but were too low at lesser Sc_2O_3 concentrations. The value of χ_m in the system decreased with increasing titanium oxide content, owing to formation of $Ti^{3+}-Ti^{3+}$ pairings, as observed for pure Ti_2O_3. (auth)

37776 ELECTRICAL PROPERTIES OF URANIUM OXYCARBIDES. Larin, A. A.; Vlasov, V. G. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Neorg. Khim.; 17: No. 2, 291-4(Feb 1972). (In Russian).

The specific electric resistance of uranium oxycarbides was measured over the range 80 to 1200°K. The resistance increased with increase in temperature and oxygen content of the oxycarbide. Related to these phenomena was the existence of both exchange and Coulombic metal–metal and metal–metalloid interactions, associated with the degree of defectiveness of these compounds with the use of 5f- and 6d-electrons of the U atom, and 2p-atoms of the metalloids possessing π-bond symmetry. (tr-auth)

37777 MAGNETIC PROPERTIES OF SOLID SOLUTIONS IN THE SYSTEM V_2O_3–Cr_2O_3 AT 80 TO 320°K. Perelyaev, V. A.; Shveikin, G. P. (Inst. of Chemistry, Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 7: No. 11, 1820-2(Nov 1971).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 7: No. 11, 2045-7(Nov 1971).

Studies on solid solutions in the system $V_2O_3-Cr_2O_3$ showed that the incorporation of Cr^{3+} cations into V_2O_3 increased the magnetic susceptibility. The value of the jump in the magnetic susceptibility of V_2O_3 at T_n decreased with increasing Cr content; the jump was not observed for the composition $(V_{0.7}Cr_{0.3})_2O_3$. With increasing Cr content of the solid solutions, T_n of V_2O_3 first increased somewhat, but then began to fall. The increase in T_n was due to intensified cation–cation interaction, and the subsequent decrease was due to electronic transition. The system $(V_{1-x}Cr_x)_2O_3$ may be divided into three regions as regards magnetic behavior; a region of solid solutions ($x \leq 0.2$), the magnetic properties of which are like those of V_2O_3; an intermediate region ($0.2 < x < 0.5$), where the Curie–Weiss law is obeyed; and a region of solid solutions ($0.5 \leq x \leq 1$), the magnetic properties of which are like those of Cr_2O_3. (auth)

37778 MICROWAVE ABSORPTION IN ERBIUM AT 24 AND 100 GHz. Hart, L. W.; Stanford, J. L. (Ames Lab., Iowa). J. Appl. Phys.; 43: No. 6, 2880-3(Jun 1972).

Microwave absorption studies in Er single crystals were made at 24 and 100 GHz. Temperatures from 4.2 to 300°K and magnetic fields up to 20 kOe at 24 GHz and up to 50 kOe at 100 GHz were used. No spin-wave resonance absorption was observed with a magnetic field along the $\langle 0001 \rangle$, $\langle 10\bar{1}0 \rangle$, or $\langle 11\bar{2}0 \rangle$ directions in Er at either of two experimental frequencies, in accord with theory. Several previously reported magnetic transitions were observed: (i) the cone-ferromagnetism–fan-ferromagnetism magnetic transition for H_{dc} in the hexagonal plane ($T < 18$ K); (ii) the antiferromagnetic—ferromagnetic transition for H_{dc} in the $\langle 0001 \rangle$ direction ($T > 18$ K); (iii) the antiferromagnetic–paramagnetic transition for H_{dc} in the $\langle 0001 \rangle$ direction ($T \cong 80$ K). Magnetic phase transitions not previously reported for Er were observed for H_{dc} in the $(10\bar{1}0)$ plane for T = 7 to 42 K. Microwave absorption associated with magnetostriction is also observed in Er for an applied field in the hexagonal plane for T = 18 to 51 K. (auth)

37779 NEUTRON DIFFRACTION AND OTHER STUDIES OF MAGNETIC ORDERING IN PHASES BASED ON Cr_2O_3, V_2O_3, AND Ti_2O_3. **Reid, A. F.** (CSIRO, Port Melbourne, Australia); **Sabine, T. M.; Wheeler, D. A. J. Solid State Chem.; 4: No. 3, 400-9(May 1972).**

Solid solutions in the $Cr_2O_3-V_2O_3$ and $Cr_2O_3-Ti_2O_3$ systems have been examined by neutron diffraction, x-ray diffraction, electron spin resonance, and magnetic susceptibility methods. In $(Cr_xV_{1-x})_2O_3$ the low temperature monoclinic V_2O_3 phase was found to extend from x = 0 to x = 0.5. Long-range order in this phase disappeared gradually as x increased. For $0.4 < x < 1.0$ two kinds of antiferromagnetic order were observed, both based on the Cr_2O_3 magnetic structure. In $(Cr_xTi_{1-x})_2O_3$ only the Cr_2O_3-type antiferromagnetic structure was found with the Ti^{3+} ions acting as a simple diluent. The electron spin resonance signal from Cr^{3+} in $(Cr_xV_{1-x})_2O_3$ was found to be quenched by dipolar interaction with V^{3+}; however, that for Ti^{3+} in $(Cr_xTi_{1-x})_2O_3$ was observable above and below the temperature for Cr^{3+} spin ordering. The lattice parameters for the $(Cr_xV_{1-x})_2O_3$ system showed a sharp discontinuity in the region $0 < x < 0.02$. From the data outside this region an ionic radius for paramagnetic V^{3+} of 0.645 Å was derived. It was found that, for many corundum-structure magnetic systems, ordering is independent of the spin state of the diluent atoms. (auth)

37780 EMISSION CHARACTERISTICS OF SOME DILUTE TUNGSTEN ALLOYS. **Jacobson, Dean Leo** (Xerox Corp., Pasadena, Calif.). **Met. Trans.; 3: No. 5, 1263-8(May 1972).**

The effective work functions of nine tungsten-base alloys were measured. The second constituents were: 5% Re; 15% Re; 2.5% Os; 5% Os; 1% Ir; 2% Ir; 5% Ta; 10% Ta; and 26% Ta. Work functions were determined from vacuum emission vehicle and thermionic emission microscope measurements. Mosaics of each surface were produced from the microscope which show the grain structure of the alloys and some anomalous emission areas. Some exceptionally high bare work functions were observed from samples with small alloy additions. For example, the work function of W-1% Ir was 5.3 eV. (auth)

37781 SEMIEMPIRICAL INVESTIGATION OF THE ELECTRONIC ZONES IN CRYSTALS WITH ZINC-BLENDE STRUCTURE. **Shifrovich, E. I.; Balyavichyus, L. Z.; Batarunas, I. V.** (Inst. of Physics and Mathematics, Vilnyus, USSR). **Liet. Fiz. Rinkinys; 11: No. 6, 1007-11(1971).** (In Russian).

A Wolsberg–Helmholz-type semi-empirical method for calculation of the electronic gap in crystals with zinc-blende structure at k = 0 is applied. On the basis of the theory outlined in an earlier paper, electronic gaps of the crystals AlAs, GaAs, AIP, and BN with different effective charges (Z) on atoms were calculated. The results show strong dependence of the calculated gap on Z, but if Z is close to 0.5 e, the experimental value can be obtained. (auth)

37782 CORRELATION OF HARDNESS TRENDS WITH d ELECTRON-TO-ATOM RATIO IN REFRACTORY HARD METALS. **Siegel, E. J.** (Michigan State Univ., East Lansing). **Phys. Status Solidi (a); 11: No. 1, 45-55(16 May 1972).**

Dempsey's assumption of a metallic type band model for 3d, 4d, and 5d refractory hard metals based on the donation of p electrons from the anion atom (B, C, N) into the transition metal cation d band and his empirical correlation of melting temperature and electrical resistivity were extended to indentation microhardness. It is seen that only the 4d diborides and the 5d dimetal carbides (bicarbides) violate the rule, and these only to shift the hardness maxima in their series from 5.5 d electrons per atom to 7.0 and 6.5 d electrons per atom, respectively. At any d electron per atom ratio, however, the order of compounds on the melting temperature and hardness plots can vary. (auth)

37783 ROLE OF IMPURITIES IN LOW-TEMPERATURE SOFTENING PHENOMENA. **Pink, E.** (Univ. of Oxford). **Phys. Status Solidi (a); 11: No. 1, 87-99(16 May 1972).**

Existing experimental results are compared with low temperature deformation theories. The discussion is restricted to cases where impurities, not substitutional alloying elements, are effective in a direct or indirect manner, and it will be based on the work on iron–nitrogen single crystal alloys by Nakada and Keh (Acta Metall. 16, 903(1968)) and that on niobium–oxygen alloys, investigated by Ravi and Gibala (Acta Metall. 18, 623(1970)). A modification of a double kink mechanism due to periodic internal stress fields cannot fully explain the reported features in interstitial alloys. It is shown that interstitial solution softening is consistent with assuming a predominance of an impurity-controlled mechanism whose importance vanishes below 100°K. When the impurity content approaches or exceeds the solubility limit a similar softening occurs, but different activation parameters suggest the contribution of a non-conservative movement of jogs in screw dislocations. (auth)

37784 PROPERTIES OF HIGH-PERMEABILITY NICKEL–IRON–TUNGSTEN ALLOYS. **Hofmann, U.** (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden. **Phys. Status Solidi (a); 11: No. 1, 145-52(16 May 1972).**

The dependence of the crystal magnetic energy constant K_1 and the magnetostriction constants λ_{100} and λ_{111} on chemical composition and atomic ordering of high-permeability Ni–Fe–W alloys is investigated. The zero-lines $K_1 = 0$, $\lambda_{100} = 0$, and $\lambda_{111} = 0$ are given in the composition diagram. Furthermore, data are given of the saturation induction, Curie temperature, electrical resistivity, and permeability. The atomic order has a strong influence on K_1, a weak one on λ_{111}, and a negligible one on λ_{100}. The best, soft magnetic properties are expected near the composition 77 wt % Ni, 13 wt % Fe, 10 wt % W. The Ni–Fe–W alloys show in the concentration area of high permeability the same magnetic and electric properties as other high-permeability alloys based on Ni–Fe with transition metals as alloying metal. (auth)

37785 SUPERFERROMAGNETISM IN GADOLINIUM FILMS. **Bostanjoglo, O.; Roehkel, K.** (Technische Univ., Berlin). **Phys. Status Solidi (a); 11: No. 1, 161-6(16 May 1972).**

Superferromagnetism is investigated using Gd films as an example. Polycrystalline films were found to split into magnetic clusters. Below the bulk Curie point, T_C, they are ferromagnetic. Due to weakened interactions between them magnetic long-range order is established only below a critical temperature $T_{cr} < T_C$. Applying molecular field and spin-wave theory to interacting clusters, the experimental film magnetization is fairly reproduced. Cluster diameter, critical temperature, and film magnetization as a function of temperature coincide for films with widely different crystal diameters, the cluster diameter (≈9 Å) being smaller than the latter (15 to 80 Å). In the case of Gd the subdivision of the ferromagnet into clusters is due to decoupling oxides. (auth)

37786 MAGNETIC IRREVERSIBILITY AND MICROSTRUCTURE OF A Nb–40 AT. PERCENT Ti ALLOY. **Witcomb, M. J.; Narlikar, A. V.** (Univ. of Lancaster, Eng.). **Phys. Status Solidi (a); 11: No. 1, 311-18(16 May 1972).**

The effect of various heat treatments on magnetization of a Nb–40 at % Ti alloy was investigated. Microstructural detail was observed by transmission electron microscopy. The results indicate that the main flux pinning mechanism in this material is due to a rearrangement of dislocations after heat treatment rather than to an interstitial ordering found in alloys having higher Ti content. This conclusion was supported by x-ray diffraction and detailed size-effect measurements. Magnetic hysteresis was a maximum when a nonuniform dislocation distribution was present, dislocations being in the form of tangles. (auth)

37787 PHASE TRANSFORMATION OF TWINNED VO_2 CRYSTALS OBTAINED BY MEANS OF CHEMICAL TRANSPORT METHOD. **Przedmojski, J.** (Technical Univ., Warsaw); **Pura, B.; Piekarczyk, W.; Gazda, S. Phys. Status Solidi (a); 11: No. 1, K1-4(16 May 197).**

An x-ray investigation on single crystals of VO_2 at temperatures up to 200°C is reported. The crystals of VO_2 were obtained by means of the chemical transport method in a closed system using $TeCl_4$ as transport agent. No phase transition was observed at the temperature 62°C as was previously reported. The transition into the tetragonal phase at the temperature (67 ± 1)°C was the only one observed. Lauegrams and photographs of rotating and oscillating crystals prove that the crystals exhibit three mutually perpendicular directions leading to the diffraction class D_{2h}–mmm. Periods of identity in these directions are a = 4.55 Å, b = 9.10 Å, c = 5.76 Å. In spite of different external size and form, all crystals display the same structure of twinning. (D.H.M.)

37788 SUSCEPTIBILITY–KNIGHT-SHIFT CORRELATION AND BAND STRUCTURE OF VO_2. **Ford, C. J.; Segel, S. L.; Seymour, E. F. W.; Hyland, G. J.** (Univ. of Warwick, Coventry, Eng.). **Phys. Kondens. Mater.; 14: No. 2, 111-18(1972).**

The magnetic susceptibility and ^{51}V Knight shift were measured in powdered VO_2 from the semiconductor–metal transition temperature T_t = 341 to 478°K. The fact that both depend linearly on temperature enables the orbital and spin contributions to both quantities to be evaluated. The orbital and spin susceptibilities at 341°K are found to be 1.30 ± 0.07 and 7.49 ± 0.07 μemu g^{-1}, respectively, and the corresponding shifts +0.61 ± 0.04% and −1.00 ± 0.04%. The existence and magnitude of the orbital term are consistent with the currently accepted two band model of VO_2 above T_t. (auth)

37789 NORMAL AND SUPERCONDUCTING PROPERTIES OF METALLIC GRAINS (Al) EMBEDDED IN A SEMICONDUCTOR (Ge): EXPERIMENTAL EVIDENCE FOR AN ADDITIONAL ATTRACTIVE MECHANISM BETWEEN ELECTRONS. **Fontaine,**

A.; Meunier, F. (Laboratoire de Physique des Solides, Orsay, France). Phys. Kondens. Mater.: 14: No. 2, 119-37(1972).

A resistivity study on AlGe films, co-evaporated at low temperatures, is presented, together with a structural study. A model for the calculation of granular film resistivity was developed. The study of superconducting properties reveals the existence of an additional attraction mechanism between electrons. An interpretation is given for this mechanism: there exists an attractive interaction between electrons, related through a polarization wave in the dielectric. (auth)

Moessbauer Effects and NMR

Refer also to abstracts 36197, 37497, and 37500.

37790 NMR OF HEXAGONAL AND CUBIC BORON NITRIDE. Khusidman, M. B.; Neshpor, V. S. (State Inst. of Applied Chemistry, Leningrad). Zh. Strukt. Khim.; 12: No. 6, 1094-5 (Nov-Dec 1971). (In Russian).

Previous work with NMR had already confirmed about 55% of double bond character in boron nitride. First and second moments were tested with Petrov's equation. The line width of NMR absorption by the ^{11}B nucleus in cubic boron nitride is explained by dipole–dipole interaction of magnetic nuclei. With the formula of Silver and Bray (J. Chem. Phys., 32: 288(1960)), the upper limit of possible values of the quadrupole interaction constant for ^{11}B in a tetragonal structure may be evaluated. (K.S.W.)

37791 EFFECT OF THE ABSORBER THICKNESS ON THE PHOTOELECTRON–CONVERSION ELECTRON INTERFERENCE IN THE MOESSBAUER EFFECT. West, P. (Univ., Berlin). Nucl. Instrum. Methods; 101: No. 2, 243-6(1972). (In German).

The interference amplitude for interference between photoelectrons and conversion electrons emitted following resonant γ-absorption (Moessbauer absorption) is dependent on the effective absorber thickness t. This effect can be described by representing the exact transmission integral with a Lorentzian line modified by a dispersion term of amplitude 2ξ. It is shown that the dispersion amplitude in this case may be approximated by an expansion in t. The expansion coefficients up to third order are given and the expression is compared with previous experimental measurements. (auth)

Theory

Refer also to abstract 37796.

PHYSICS (THEORETICAL)

37792 (ITF–71–122–P) COLLECTIVE VARIABLES IN N-PARTICLE SYSTEM. Dzyublik, A. Yu. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

The kinetic energy operator of N-particle system is expressed in terms of a set of independent variables. Six coordinates define the orientation of the principal axes of inertia ellipsoid and the lengths of them, 3N-9 coordinates define orientation of three orthogonal vectors in (N-1)-fold abstract space. (auth)

37793 (ITF–71–126–P) ON THE METHOD OF CALCULATING THE QUASI-AVERAGES FOR SOME MODEL SYSTEMS WITHOUT SOURCES. Bogolyubov, N. N. Jr. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

Some features of the definition of quasi-averages for the model systems by means of the four-fermion interaction are considered. A new method of defining the quasi-averages for the model systems under consideration is suggested. (auth)

37794 (ITF–71–127–P) VIBRATION-ROTATION EXCITATIONS OF FOUR PARTICLE SYSTEM. Dzyublik, A. Ya. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1971. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The fixed body coordinate system connected with the instantaneous principal axes of inertia of four particles is used to extract the rotation of four particle system. The symmetry of collective coordinates of four particles is considered. For XY_3-molecule the symmetric wave function is constructed and rotational energy is calculated. (auth)

37795 PROBLEMS IN THE FOUNDATIONS OF PHYSICS. Bunge, Mario (ed.). Studies in the Foundations. Methodology and Philosophy of Science. 4. New York; Springer-Verlag New York Inc. (1971). 170p. $17.00.

The topics discussed are mathematical theory of the dimensions and units of physical quantities, variational principles and invariance theory, Galilei- and Lorentz-invariant particle systems and their conservation laws, foundations problems in general relativity, and a global approach to geometry and physics. Also probability in quantum mechanics and other statistical theories, the localization problem, semantic foundations of the quantization program, algebraic aspects of formal chemical kinetics, and the relevance of philosophy to physics are treated. (J.F.P.)

37796 QUANTUM MECHANICS OF MANY-BODY SYSTEMS. Thouless, D. J. Pure and Applied Physics, Volume 11. New York; Academic Press, Inc. (1972). 252p. $13.50.

The topics discussed cover soluble models, variational methods, perturbation theory, low-lying excited states, impurities and random systems, statistical mechanics and superconductivity theory, perturbation theory at finite temperatures, Green functions at finite temperatures, and bosons. The problems considered arise in nuclear, atomic, solid-state, low-temperature, and elementary particle physics. (J.F.P.)

37797 NORMALIZATION OF CERTAIN HIGHER-ORDER PHASE-INTEGRAL APPROXIMATIONS FOR WAVEFUNCTIONS OF BOUND STATES IN A POTENTIAL WELL. II. Yngve, Staffan (Uppsala Univ.). J. Math. Phys. (N. Y.); 13: No. 3, 324-31 (Mar 1972).

Using a formula derived from equations given by Furry for the normalization integral of the wavefunction corresponding to a bound state, the normalization factor is derived for the higher-order phase-integral approximations introduced by N. Fröman. The present treatment is based on the method developed by N. Fröman and P. O. Fröman, in which one uses exact formulas in the calculations and makes the approximations in the final stage. The resulting general formula is particularized to the case of a single-well potential previously discussed and to the case of a double-well potential, which has been treated previously. (auth)

37798 ANALYSIS OF LATENT REGULARITIES BY MEANS OF REGULARIZED ITERATION PROCESSES. Aleksandrov, L. (Joint Inst. for Nuclear Research, Dubna, USSR); Gadjokov, V. J. Radioanal. Chem.; 9: No. 2, 279-92(Dec 1971).

To find presumed regularities by means of analyzing observations on physical phenomena is a problem which frequently arises in calculation practice. An attempt is made to provide a general mathematical formulation of this problem and to connect its occurrence to an effective research strategy. A general calculational approach to the analysis of latent regularities, based on regularized and autoregularized iteration processes for solving nonlinear problems, is suggested. Some particular classes of problems are discussed and actual numerical examples are given. (auth)

37799 EQUIVALENCE OF TWO TRANSFORMATION THEORIES. Rae, J. (Univ. Libre, Brussels). Lett. Nuovo Cim.; 3: No. 12, 520-2(18 Mar 1972).

It is shown that when finite systems are considered (when no thermodynamic limit is taken) for which the Hamiltonians satisfy assumptions made previously the superoperator transformation theory developed by Prigogine et al and a transformation theory developed by Kummer with the idea of avoiding secular terms in dynamical perturbation theories are equivalent. (J.F.P.)

37800 NONLINEAR PERTURBATION OPERATORS. Andrews, L. C. (Magnavox Co., Fort Wayne); Triffet, T. J. Math. Phys. (N. Y.); 13: No. 3, 419-33(Mar 1972).

A systematic perturbation theory is presented for the analysis of nonlinear boundary-value problems. In particular, those equations are considered whose unperturbed form belongs to the class of linear special-function equations; the nonlinear terms are then regarded as perturbations of special-function operators. Utilizing the coordinate representation of quantum mechanics, a matrix representation is obtained for the perturbed operator, truncation and diagonalization of which will determine the perturbed eigenvalues and eigenvectors. In most cases the method is applicable even when the perturbation term is of the same order of magnitude as the remaining terms, perhaps even when it is larger. To illustrate this point the nonlinear Legendre-like equation $(d/dx)\,(1 - x^2)(du/dx) + \lambda u + \alpha x^2 u^2 = 0$ is solved for the cases when $\alpha = 1$ and $\alpha = 5$. Other examples include the Hartree equations for the helium atom, where a qualitative comparison of the ground-state energy is made with experimental data, and a detailed analysis of the van der Pol equation for $\alpha = 0.5$ and $\alpha = 1$. (auth)

37801 MODIFICATION AND DESTRUCTION OF ADIABATIC INVARIANTS DUE TO RESONANCES. Jaeger, Erwin Frederick. Berkeley, Calif.; Univ. of California (1970). 152p. University Microfilms Order No. 71-15,801.

Thesis.

Two-dimensional Hamiltonians that result from removal of intrinsic and accidental degeneracies are considered. One such Hamiltonian is of the form: $K = \psi(P_1) + \epsilon\,\Omega(P_1,P_2,q_1,q_2)$. Different forms result depending on the type of degeneracy removed. The Hamiltonian is averaged over q_1 ignoring resonances between the two degrees of freedom. Numerical integration of Hamilton's equations before averaging shows the maximum value of ϵ for which the average is valid. P_2 is found to oscillate but as long as the average is valid, this oscillation is adiabatically separated from the rest of the motion by the existence of an adiabatic invariant or isolating integral which is P_1 to lowest order. When resonant coupling occurs between the two degrees of freedom, the averaging is not valid and the adiabatic invariance of P_1 is destroyed. In this case, a canonical transformation is used to remove the resonance. This transformation puts the observer in a frame of reference that rotates with the resonant frequency. Taking the average in this frame reveals a new oscillation in the previously constant adiabatic invariant, P_1, about its resonant value. If oscillations about neighboring resonances do not interact, a new approximate invariant exists that leads to islands in the $P_2 - q_2$ phase plane. If interaction occurs, the oscillations are no longer adiabatically separated and no invariant exists. Numerical examples include single-particle motion in a magnetic mirror with rf perturbation and the nonlinear coupled oscillator. (Diss. Abstr. Int., B)

REACTOR TECHNOLOGY

Power Reactor Development

Refer also to abstract 36481.

37802 CLASSIFICATION SYSTEM FOR NUCLEAR REACTORS. DIN 25 402-1969. Berlin; Fachnormenausschuss Kerntechnik (1969). 17p. (In German).

The various types of nuclear reactors are classified according to purpose, components, and technical design. For each type, the German term is listed as well as the corresponding expression in English, French, Italian, Dutch, and Russian. (H.B.G.)

37803 PRELIMINARY DESIGN OF THE EXPERIMENTAL MULTI-PURPOSE HIGH TEMPERATURE REACTOR. Tsunoda, Ryokichi (Fuji Electric Co. Ltd., Tokyo). Fuji Jiho; 44: No. 10, 907-16(Oct 1971). (In Japanese).

Japan Atomic Energy Research Institute (JAERI) plans to develop and construct a 50MW(e) experimental multi-purpose high temperature gas-cooled reactor by 1976. The preliminary design of the experimental multi-purpose high temperature reactor is described. The general description and design characteristics of the reactor are presented. The core structure and the cooling system are described. (Japan)

37804 REAKTORTECHNIK. T. 2. ANWENDUNGEN. (Reactor Engineering. Pt. 2. Applications). Smidt, D. Karlsruhe, Ger.; Braun (1971). 292p.

Design, dynamics, cost calculations, plant optimization, reactor safety techniques and shielding calculations are presented. Tables showing technical specifications of the most important power reactors being built or planned are given. (INIS)

Physics and Core Engineering

Refer also to abstract 38016.

37805 (ANL-7411(Suppl.6)) ARGONNE CODE CENTER: COMPILATION OF PROGRAM ABSTRACTS. Butler, M. K.; Henline, Pamela; Legan, Marianne; Ranzini, L.; Snow, William J. (Argonne National Lab., Ill.). Mar 1972. Contract W-31-109-eng-38. 370p. Dep. NTIS.

A bibliography of computer program abstracts referring to computer programs available at the Argonne Code Center is presented. (D.C.C.)

37806 (EUR-4731, pp 21-39) STATUS REPORT ON SEVERAL METHODS FOR PREDICTING THE SPACE-TIME DEPENDENCE OF NEUTRONS IN LARGE POWER REACTORS. Henry, A. F. (Massachusetts Inst. of Tech., Cambridge). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

For several years a number of different methods for predicting the space-time behavior of neutrons in large power reactors have been under development in the United States. These include direct solution of the space and time differenced group diffusion equations as well as adiabatic, modal and nodal approximations to such solutions. Although the mathematical formulation of all these approaches has been available for some time, only a few of the methods have been implemented to the point that detailed, design-type calculations can be performed. The status of several of the calculational schemes which have received the greatest attention to date is reviewed. Some of the problems encountered in creating practical design programs are described along with efforts to improve the overall efficiency of the methods. The particular virtues and shortcomings of the different schemes when applied to different types of transient analyses are summarized. 47 references. (auth)

37807 (EUR-4731, pp 181-7) CALCULATING POWER REACTOR EXCURSIONS WITH SPACE DYNAMICS METHODS. Loizzo, P.; Norelli, F. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

Several mathematical and physical models were developed to represent the space-time behavior of a power reactor during an excursion. A good many of these models were implemented in the code ALADINO which is a rather flexible tool and a testing ground for checking the various physical and mathematical approximations. The code is briefly described. (auth)

37808 (EUR-4731, pp 207-35) ANALYSIS OF SPACE-DEPENDENT DYNAMICS IN POWER REACTORS AND THE COMPUTER CODE SPEC-FR. Wakabayashi, Jiro; Yoshikawa, Hidekazu (Kyoto Univ. (Japan). Engineering Research Inst.). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

An approximate calculational model for long period power excursions is described. The code SPEC-FR is applied to space dependent dynamics of LMFBR cores. (H.D.R.)

37809 (EUR-4731, pp 237-51) TWO-DIMENSIONAL MODEL FOR FAST REACTOR KINETICS ANALYSIS WITH SPACE DEPENDENT FEEDBACK. Struwe, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

The time-discontinuous synthesis method, including detailed space-dependent feedbacks, is used to describe the space-dependent dynamic behavior of fast reactors. The space-dependency of the neutron flux, the material temperatures, and the feedbacks are treated in cylindrical geometry. Two-dimensional trial functions for the multigroup fluxes and the concentration of the precursors are determined by an iterative procedure. (auth)

37810 (EUR-4731, pp 253-60) TWO DIMENSIONAL CALCULATION OF REACTOR EXCURSIONS WITH THE QUASISTATIC METHOD. Mayer, L.; Bachmann, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

The quasistatic method for analysis of space dependent dynamics during fast reactor excursions is described. A computer code, KINTIC, based on the quasistatic method is discussed. (H.D.R.)

37811 (EUR-4731, pp 305-18) 2001: TWO-DIMENSION SPATIAL DYNAMICS CODE FOR NUCLEAR REACTOR CONTROL AND SAFETY STUDIES. Brusa, L.; Giorcelli, M.; Magni, A.; Piccolo, E.; Pogliani, E. (Centro Informazioni Studi Esperienze, Milan (Italy)). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

A two-dimensional spatial dynamics code developed at CISE for nuclear reactor control and safety studies is described. The general organization of the code is given, with particular reference to its first version, most suitable for the control system design of large CIRENE type power reactors. 13 references. (auth)

37812 APPLICATION OF Gd AS A BURNABLE POISON FOR LIGHT WATER REACTORS. Orestano, F. V.; Pistella, F. (CNEN, Rome). Energ. Nucl. (Milan); 19: No. 5, 337-41 (May 1972).

The use of Gd as a burnable poison for light water reactors improves the reactivity evolution vs. burn-up as well as improves power distributions in the core. The calculational method developed to account for the effects connected with the depletion of Gd in actual operating conditions vs. lifetime is presented. Applications to a PWR as well as to a BWR are reported. 12 references. (auth)

37813 REAKTORTECHNIK. T. 1. GRUNDLAGEN. (Reactor Engineering. Pt. 1. Fundamentals). Smidt, D. Karlsruhe, Ger.; Braun (1971). 255p.

The fundamentals of reactor and neutron physics, material science as well as the cooling techniques and the flow mechanics for reactor design are presented. (INIS)

37814 FAST AND/OR THERMAL BREEDERS. THE DEVELOPMENT OF A LIQUID FUEL THERMAL BREEDER REACTOR IN THE NETHERLANDS. Went, J. J.; Hermans, M. E. A. (KEMA, Arnhem, Netherlands). Elektrotechniek; 49: 59-67(21 Jan 1971).

In the Netherlands aqueous suspensions are being studied with respect to their potential as a nuclear fuel for a homogeneous reactor. Both the features of this type of reactor and a number of the most relevant problems encountered in its development are discussed. (auth)

37815 SIMULATION EXPERIMENT ABOUT THE EFFECTS OF CORE HETEROGENEITY ON THE TRANSIENT PRESSURE BEHAVIOR IN THE HIGH-ENERGY EXCURSION OF FAST REACTOR. Kondo, Shunsuke; Mukai, Hiroshi; Imai, Tetsu (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 2, 127-9(Feb 1972).

Control and Instrumentation

Refer also to abstract 36490.

37816 (CONF-720420-5) BORON CONCENTRATION GRADIENT FOR IMPROVED THERMAL REACTOR PERFORMANCE OF BORON-STAINLESS STEEL CONTROL RODS. Beaver, R. J.; Richt, A. E. (Oak Ridge National Lab., Tenn.). [1964]. 29p. Dep. NTIS.

From seventeenth annual ISA analysis instrumentation symposium; Houston, Tex. (19 Apr 1971).

The performance of conventional 2 to 3 wt % ^{10}B-stainless steel alloys and powder dispersions is limited in thermal reactors because the ^{10}B(n,α) reactions are localized at and near the surface of the material. Significant swelling occurs after a relatively short exposure, and additional exposure creates drastic damage to the microstructure in the localized regions. By designing a symmetrical boron concentration gradient in which the ^{10}B is limited at the surface and increases in a prescribed manner to higher concentrations below the surface, the performance capability of boron-stainless steel neutron absorbers can be increased substantially. Test results for boron concentration gradient rods are presented. 7 references. (auth)

37817 ON-LINE COMPUTERS FOR NUCLEAR POWER PLANTS USING BWR. Ito, Mutsumi (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan); Miyamoto, Toshiki; Kawahara, Haruo. Karyoku Hatsuden; 22: No. 10, 1140-6(Oct 1971). (In Japanese).

On-line computers are used in recent BWR power plants as essential components. Functions of a domestic on-line computer, TOSBAC-7000/20, are described. The functions of the computer are for basic programming, plant-state monitoring, calculation of plant performance and core performance and operational auxiliary function. The core performance is calculated with the computer on heat output, power output distribution, thermal-hydraulic aspects, and ratio of linear power density and limiting heat flux. A core simulator containing all the necessary items was developed. Future developments for on-line computers are discussed. (Japan)

37818 DEVELOPMENTAL STATUS OF FAST BREEDER REACTOR. Takehara, Ken; Yokozawa, Atsushi; Yamada, Keiji (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Toshiba Rebyu; 27: No. 2, 142-6(Feb 1972). (In Japanese).

The core internals, control rods and their drive mechanisms are described in regard to their functions, structure, design, materials, manufacture and inspection. The present status of development of fast breeder reactors is outlined. (auth)

37819 ADAPTIVE CONTROL OF NUCLEAR REACTORS USING A DIGITAL COMPUTER. Bereznai, George T.; Sinha, Naresh K. (McMaster Univ., Hamilton, Ont.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-18: No. 4, 387-97 (Aug 1971).

From fourth symposium on engineering problems of fusion research; Washington, D. C. (20 Apr 1971). See CONF-710418.

An adaptive system for the control of the power level of a nuclear reactor is described. The controller has a square-law element of variable gain, optimum values for which have been obtained from off-line computations for certain power levels and parameter values. When conditions in the reactor deviate from those assumed for the off-line optimization, the gain factor is adapted on-line, such that the difference between actual and demanded power levels is minimized. An existing power reactor and associated control system have been simulated, as well as the proposed adaptive scheme. The results show that the adaptive controller gives improvements by at least an order of magnitude in the accuracy of following power demand changes, and at the same time reduces the necessary control effort. Since the scheme entails only a small number of arithmetic and logical operations and has limited memory requirements, it may be implemented on a conventional process computer, or built as a special purpose digital control system. (auth)

Containment Systems, Waste Processing, and Radiation Protection

37820 (RDT-E-10-7-T(5-72)) BLOWDOWN SUPPRESSION TANK. (Division of Reactor Development and Technology (AEC), Washington, D. C.). May 1972. 17p. RSO.

The requirements for materials, design, fabrication, testing, inspection, shipping, and certification of a blowdown suppression tank conforming to ASME Boiler and Pressure Vessel Code (ASME Code), Section III, Class 2, are presented. (auth)

37821 (WCAP-7820(Suppl.)) ELECTRIC HYDROGEN RECOMBINER FOR PWR CONTAINMENTS. Final Development Report. Wilson, J. F. (comp.) (Westinghouse Electric Corp., Pittsburgh, Pa.). May 1972. 46p.

A new type of hydrogen recombiner design for use in reactor containments following a postulated loss-of-coolant accident is described. This recombiner uses electric resistance heaters to heat a continuous flow of containment atmosphere above the hydrogen-oxygen reaction temperature, thereby causing the hydrogen to combine with the oxygen which is being processed by the recombiner. Design requirements and performance characteristics, the results of proof-of-principle tests, and results of tests of a full-sized prototype recombiner unit for pressurized water reactor application are presented. (auth)

Coolant System

Refer also to abstract 36285.

37822 (KFK-1541) SODIUM BOILING EXPERIMENTS IN A FUEL ELEMENT MODEL. Cramer, M.; Dorr, B. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan 1972. 51p. (In German). Dep. NTIS (U. S. Sales Only).

The Na boiling experiments performed on a model of a full-sized fuel element of the DEBENELUX Fast Breeder Reactor planned by the Federal Republic of Germany, Belgium, the Netherlands and Luxemburg are described. The boiling events and the motion of bubbles in this element model are discussed by means of measured temperature curves. The experiments are conducted within the framework of safety assessments of fast sodium cooled reactors. The experiment shows that pressure stress exerted on the wall of the fuel element box through boiling and condensation impact is kept at such a low level that no destruction or unacceptable deformation of the parts should be anticipated. (6 references) (auth)

37823 (RD/B/N-2094) BEHAVIOUR OF RADIOACTIVE ISOTOPES IN LIQUID METAL COOLED FAST REACTORS. PART IV. ADSORPTION OF CESIUM ON STAINLESS STEEL FROM SOLUTION IN LIQUID SODIUM. Evans, H. E.; Watson, W. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Dec 1971. 17p. Dep. NTIS (U. S. Sales Only).

A radioactive tracer technique was employed to study adsorption of cesium on stainless steel (EN58B) and nickel surfaces. Adsorption was observed in the range 373°K to 573°K but was eliminated by heating the metals in sodium at 1073°K. Comparison of adsorption equilibrium constants with those reported elsewhere gave reasonable agreement for a similarly pretreated surface but rates of equilibrium were lower than those reported elsewhere. Factors governing cesium adsorption are discussed but there is insufficient evidence to deduce the mechanism of adsorption. (auth)

37824 (RD/B/N-2282) ESTIMATION OF TRANSPORT PROPERTIES AND PUMPING POWER PARAMETERS FOR MIXTURES OF HELIUM AND CARBON DIOXIDE. Easby, J. P. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Mar 1972. 24p. Dep. NTIS (U. S. Sales Only).

An investigation was made into the estimation of gas transport properties and reactor pumping power parameters for mixtures of He and CO$_2$. A lack of experimental information prompted the adoption of calculation procedures for viscosity and thermal conductivity. For viscosity a theoretically based method predicted the experimental data investigated to better than 4% and for thermal conductivity a semi-empirical method agreed within 5%. Calculations of gas properties and pumping power parameters were performed for He-CO$_2$ mixtures at 40 bar, 600°C and showed that there was little advantage to be gained on pumping power by using mixtures rather than pure helium. (auth)

37825 (RDT-E-4-14-T(4-72)) VAPOR TRAP ASSEMBLIES FOR SODIUM SERVICE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1972. 45p. RSO.

The requirements are presented for the design, fabrication, quality assurance and shipment of vapor trap assemblies for use where removal of sodium vapor, fog and other aerosols from an inert gas cover stream is required to prevent plugging of downstream lines by solid sodium and to protect downstream equipment from its effects. (auth)

37826 NUCLEAR REACTORS. Hooper, Alan Thomas (to United Kingdom Atomic Energy Authority). U. S. Patent 3,658,645. 25 Apr 1972. Priority date 7 Feb 1968, Great Britain.

In a nuclear reactor fueled with porous fuel and having a fluid coolant, the coolant enters the core axially and traverses the porous fuel in a radial sense before leaving the core in a continuing radial direction. Pressure drop between inlet and outlet passages is reduced by avoiding the need for the coolant to pick up axial momentum on leaving the fuel. (auth)

37827 GAS PURIFYING APPARATUS. Gramer, Gottfried (to Siemens Aktiengesellschaft). U. S. Patent 3,658,485. 25 Apr 1972. Priority date 20 Mar 1963, Germany.

In a closed coolant loop of a nuclear reactor there is provided an apparatus for purifying contaminated nuclear reactor coolant gas of nuclear decomposition products. A filtering system is provided for filtering a uniform flow of contaminated gas, the filtering system having components consisting at least partly of copper, gas removing device for removing a test quantity of the contaminated gas flowing through the filtering system, and gas testing means connected to the gas removing device for receiving the test quantity and for analyzing the contaminating content of the test quantity. Quantities of reducing and oxidizing gases are added to the contaminated gas so as to simultaneously regenerate the components of the filtering system as the contaminated gas is being purified. (auth)

37828 IMPROVEMENTS IN OR RELATING TO PURIFYING INERT GAS STREAMS. Romberg, Ernst Gustav Heinrich (to United Kingdom Atomic Energy Authority). British Patent 1,270,258. 12 Apr 1972. Filed 21 May 1968.

An improved method is described for purifying streams of inert gases, such as He, Ar or N_2, applicable to the removal of CO_2 in the presence of water vapor from graphite reactor coolant gas streams. A volatile alkaline or acidic additive is added to form with the contaminant a less volatile product which is then trapped on porous sorbent material by sorption or filtration. Where two or more contaminants are present an additive may be employed that reacts with one of the contaminants on the surface of the sorbent to form a compound that in turn reacts with a second contaminant to produce a further compound, which is trapped together with any residual contaminants. For purification from water vapor and CO_2 the gas stream may be contacted with NH_3 and led to a sorption filter for reaction and trapping the compounds formed. A synthetic zeolite molecular sieve filter bed may be employed. Physical processes and reaction mechanisms occurring are discussed, and the method of regeneration of the sorbent bed is described. (UK)

37829 TURBOBLOWERS FOR NUCLEAR POWER PLANTS. Aull, O.; Koenig, H. D. Demag Nachr.; No. 195, 19525-31 (1970). (In German).

Special problems are discussed that arise during construction and operation of compressors for nuclear reactors. A description is given of the blowers of the Nuclear Power Station Niederaichbach. (INIS)

Fuels and Fuel Elements

Refer also to abstract 36492.

37830 (BAW-3647-24) PHYSICS VERIFICATION PROGRAM. PART III. TASKS 5, 6, AND 7. Summary Report. Baldwin, M. N.; Fairburn, G. T. (Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.). Mar 1972. Contract AT(11-1)-3109. 99p. Dep. NTIS.

The response of all-solid, self-powered, incore neutron flux detectors is correlated to the power density profiles of a critical assembly. The experimental assembly, a water-moderated, slightly enriched UO_2 lattice perturbed by Ag-In-Cd poison pins and dissolved boric acid, is arranged to mockup the fuel elements of a commercial pressurized water reactor. A plutonium lattice for obtaining data for verification of the analytical methods and models developed for the design of water-moderated, plutonium-recycle cores is described. The lattice system is designed to provide a critical assembly with a small central test region and a nearly flat flux and asymptotic spectrum. The test region is incrementally poisoned with boric acid until a void substitution yields a null reactivity change. This provides a precise measure of the boron concentration required to reduce to unity the infinite-medium multiplication factor of the test lattice. Measurements of the effect of B_4C rods on the reactivity and power distribution in UO_2 lattices are described. (10 references) (auth)

37831 (FOA-4-4487) ^{233}U, NUCLEAR CHARGES AND ADVANCED REACTORS. Wallin, Lars B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1972. 44p. (In Swedish). Dep. NTIS (U. S. Sales Only).

The production of ^{233}U is studied. The supply of ^{233}U will increase when reactors operating on the ^{233}U-Th cycle start running. The uses of the ^{233}U are discussed. (42 references) (Sweden)

37832 (GEAP-13765) DESIGN BASIS OF THE F9E GRID SPACED LMFBR DIAGNOSTIC ASSEMBLY FOR IRRADIATION TEST IN EBR-II. Pluta, P. R.; Meinhardt, W. G. (comps.) (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1971. Contract AT(04-3)-189. 165p. Dep. NTIS.

The F9E group is the first in-pile test of a grid spaced fuel assembly utilizing the straight-wave beam grid spacer concept. This diagnostic test is designed to produce conditions in the EBR-II assembly that simulate design limiting conditions in the LMFBR. Assembly design and design methods can be evaluated and improved based on a comparison of the predicted performance with the actual grid assembly performance observed during the interim and post-irradiation examination. (27 references) (auth)

37833 (TID-26027) FUEL MANAGEMENT USING DYNAMIC PROGRAMMING. Owen, Michel Boyd (Texas Univ., Austin). May 1972. 67p. Dep. NTIS.

Thesis.

The classical approach of dynamic programming is applied to a one-dimensional nuclear reactor model to demonstrate its feasibility as a method of fuel management. The method is made possible with two basic assumptions which determine when the plant will be refuelled, and which fuel regions will be replaced. Ten shuffling rules are used in the study. A reactor model is simulated with a computer program, incorporating the method of Lagrangian Expansions. The model is used to simulate shuffling and burnup of fuel within a reactor core. The feasibility of dynamic programming is shown using three different objectives to find many optimal policies for a plant life duration of several months to ten years. This problem in optimality was solved previously by Wall and Fenech using a different interpretation of dynamic programming which limits the information obtained to one plant lifetime only. (24 references) (auth)

37834 IRRADIATION PLAN AND PHYSICS TEST ON PuO_2-UO_2 ASSEMBLIES IN JPDR. Matsuura, Shojiro (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 17: No. 12, 34-7(Dec 1971). (In Japanese).

The irradiation test of PuO_2-UO_2 fuel in Japan Power Demonstration Reactor is described. The background for irradiation feasibility in the JPDR, design of the PuO_2-UO_2 test assemblies, schedule of the irradiation, and reactor-physics test in a nearby critical facility are reviewed. (Japan)

37835 ANTICAVITATION DEVICE. (to Commissariat a l'Energie Atomique). British Patent 1,273,925. 10 May 1972. Priority date 13 Feb 1970, France.

REACTOR FUEL ELEMENTS—coolant flow anticavitation structure for, liquid sodium
REACTORS, LIQUID METAL-COOLED—fuel elements for, description of coolant flow anticavitation structure for (D.C.C.)

37836 PRESSURE EQUALIZATION SYSTEM FOR FUEL PINS OF WATER-COOLED REACTORS. Malang, S.; Mueller, St. (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik; 14: No. 3, 114-17(Mar 1972). (In German and English).

A pressure equalization system was developed for fuel pins of water-cooled reactors, which makes possible a major reduction of mechanical stresses in the cladding tubes. In boiling water reactors, a complete equalization of internal and external pressure can be achieved over the entire service life of the pins. This prevents a creep collapse of the cladding onto the fuel, and avoids any exchange between the coolant and fission gases in the event of small leak defects. Satisfactory functioning of the system was demonstrated in out-of-pile tests. (auth)

37837 DEVELOPMENT OF COATED FUEL PARTICLES FOR INCREASED POWER AND SAFETY REQUIREMENTS. Foerthmann, R.; Gyarmati, E.; Hilpert, K.; Nickel, H. (Kernforschunsanlage, Juelich, Ger.). Atomwirt., Atomtech.; 17: No. 5, 265-7(May 1972). (In German).

For both high temperature reactors with a helium turbine in the primary circuit and process steam reactors with high cooling medium temperature, the release of fission products by coated fuel particles was studied. In oxide fuel particles, strontium and barium were bound through the addition of aluminum oxide or zirconium oxide. At 1400°C, almost all of the barium was bound by the Al_2O_3 phase. At 1700°C, barium increasingly diffused out of the Al_2O_3 phase and back into the UO_2 phase. As coatings for fuel particles, pyrocarbon and silicon carbide were studied. Results showed that the structure of SiC played a major role. At radiation temperatures from 1150°C to 1350°C and a burnup of 6%, solid fission products penetrated low density SiC, while it was retained by high density SiC. (H.B.G.)

37838 NUCLEAR REACTOR FUEL ELEMENT. Cayol, Andre; Clottes, Georges (to Commissariat a l'Energie Atomique). British Patent 1,276,488. 1 Jun 1972. Priority date 22 May 1970, France.

REACTOR FUEL ELEMENTS—design characteristics of fission gas collection space for liquid sodium cooled pins
REACTORS, FAST—fuel pins for liquid sodium cooled, description of fission gas collection space for
REACTORS, LIQUID METAL-COOLED—fuel pins for fast, description of fission gas collection space for (D.C.C.)

Auxiliary Systems and Engineered Safeguards

37839 INSTALLATION FOR SURVEYING THE DISPLACEMENT OF A STRUCTURE IN A NUCLEAR REACTOR. Debergh, Philippe; Legrange, Maurice (to Commissariat a l'Energie Atomique). British Patent 1,273,940. 10 May 1972. Priority date 10 Apr 1970, France.

DISPLACEMENT GAGES—design characteristics of optical, for liquid sodium cooled fast reactor core support structure
REACTORS, FAST—core support structure for liquid sodium cooled, description of optical displacement gage for
REACTORS, LIQUID METAL-COOLED—core support structure for fast, description of optical displacement gage for (D.C.C.)

37840 OWN POWER SUPPLY IN NUCLEAR POWER PLANTS. EFFECTS AND REQUIREMENTS OF NUCLEAR SAFETY. Borst, A. (Kraftwerk Union AG, Erlangen, Ger.). Atomwirt., Atomtech.; 17: No. 5, 274-80(May 1972). (In German).

For nuclear power plants, extensive emergency power installations are characteristic. Increased redundancy of technical procedures protects against plant failures. A general survey and several examples describe the strong influence that nuclear safety exerts on the design of electrical installations for the power supply of nuclear plants. (tr-auth)

Operation and Economics

37841 ASSESSMENT OF NUCLEAR POWER IN THE UNITED KINGDOM. Marsham, T. N. (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Inst. Fuel; 45: No. 375, 262-75(May 1972).

The proposition that nuclear power is not a real asset to the United Kingdom is analyzed. Inevitably, as with the exploitation of any novel large-scale technological development, there have been problems both of technology and also of organization, but evidence is presented to show that the real achievements in nuclear technology in producing a base of engineering and physical resources, and the associated human and economic factors, are of much greater significance. An outline is given of the whole nuclear power industry and what has been created by its individual parts. The nuclear power stations in operation and under construction are discussed and future prospects are assessed to indicate the role of nuclear power and the benefits which should emerge from its increasing application if proper use is made of experience and resources. (auth)

Safety and Siting

Refer also to abstracts 36115, 36120, 36122, and 36130.

37842 (ORNL-NSIC-93) SUMMARY OF RECENT LEGISLATIVE AND REGULATORY ACTIVITIES AFFECTING THE ENVIRONMENTAL QUALITY OF NUCLEAR FACILITIES. Bryan, R. H.; Nichols, B. L.; Ramsey, J. N. (Oak Ridge National Lab., Tenn.). May 1972. Contract W-7405-eng-26. 175p. Dep. NTIS.

The summary information comprises: legislation adopted or pending; regulations, standards, and executive orders issued or proposed; and State water quality standards. The legislative activities presented include major laws enacted by the 91st Congress, relevant bills intoduced in the 92nd Congress, and relevant bills introduced in the current sessions of the legislatures of several States. Regulations, standards, and executive orders adopted or proposed during 1970 and 1971 on the Federal level are identified. The action is described together with information on the issuing office or agency and the status. The tabulation includes only formal actions, such as executive orders and regulations with broad public application. Water quality standards and criteria have been adopted by all states and territories of the United States. Most of these have been approved by the Environmental Protection Agency or the Federal Water Quality Administration. The essence of thermal and radiological restrictions imposed by these standards is presented. (3 references) (auth)

37843 (TID-25960) SAFETY GUIDE 17: PROTECTION AGAINST INDUSTRIAL SABOTAGE. [Division of Reactor Standards (AEC), Washington, D. C.]. 27 Oct 1971. 7p. USAEC.

A guide is presented for a suitable program of security for protection against industrial sabotage in a nuclear power plant. (H.D.R.)

37844 ASPECTS OF A SAFE DESIGN OF THERMAL REACTORS WITH REGARD TO THEIR REACTIVITY BEHAVIOUR. DIN 25 405-1970. Berlin; Fachnormenausschuss Kerntechnik (1970). 1p. (In German).

For thermal reactors, definitions are given for reactivity, reactivity equivalent, excess reactivity, initial excess reactivity, reactivity balance, shutdown reactivity, reactivity rate, and reactivity coefficient. Each of the defined terms is then discussed with respect to safety requirements. (H.B.G.)

37845 STABLE FINITE DIFFERENCE SCHEME FOR TRANSIENT FLOW IN A BOILING CHANNEL. Turner, W. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Energ. Nucl. (Milan); 19: No. 5, 317-24(May 1972).

A stable finite difference scheme for transient two-phase compressible flow including slip and spatial acceleration is presented. Local numerical stability of the scheme is proven. The method is applied to the CISE loss of inlet flow experiments and gives mean coolant density transients in good agreement with the experiments. 15 references. (auth)

37846 REACTOR SYSTEMS SAFETY RESEARCH AT PNC. At. Jap.; 15: No. 8, 11-16(Aug 1971).

Reactor-safety studies going on at Power Reactor & Nuclear Fuel Development Corporation are explained. Development and construction are proceeding on fast breeder reactors "Monju" and "Joyo," using plutonium as fuel and sodium as coolant. Safety problems with this type of reactor are re-criticality accident and the sodium as coolant. Points of research are indicated in accident analysis, safety evaluation and safety design. For an ATR, there is the "Fugen" which is heavy-water moderated and boiling light-water cooled. Safety research includes mechanical integrity of the reactor core, blow-down characteristics of a cooling system, etc. Experimental facility built for the purpose and then the results thus far obtained are described. (Japan)

Steam and Power Conversion System

37847 IMPROVEMENTS IN HEAT EXCHANGERS. Lippitsch, Josef (to Waagner-Biro Aktiengesellschaft). British Patent 1,272,313. 26 Apr 1972. Priority date 26 Jun 1968, Austria.

BOILERS—pressure barriers for gas heated
REACTORS, GAS-COOLED—steam generator for, description of pressure barriers for (D.C.C.)

37848 PROCESS FOR CONTROLLING THE POWER LEVEL OF A SYSTEM INCORPORATING A CLOSED-CYCLE GAS COMPRESSOR: AN APPLICATION. Bitsch, Daniel (to Societe pour l'Industrie Atomique. Compagnie Electro-Mecanique). French Patent 2,067,741. 26 Jul 1971. Filed 14 Nov 1969. (In French).

A process for controlling the power level of a system incorporating a closed-cycle gas compressor is described. The process is applied to a gas turbine associated with a gas cooled nuclear reactor (in particular a high temperature reactor using He as the cooling gas). The process consists of transferring the working fluid between the closed circuit and at least one buffer-reservoir, the difference between the pressure generated by the closed-cycle gas compressor and the pressure existing in the buffer-reservoir being used to effect the transfer. The device possesses at least one buffer-reservoir, joining pieces (each connected on one side to the buffer reservoir and on the other side to the gas circuit), and insulation parts mounted on the joining pieces. The mounting ensures the natural transfer of the gas between the closed circuit and the reservoir, and vice versa by the manipulation of the insulation parts. In the case of a reactor, the buffer-reservoir is situated in the sealed enclosure and will confine the radioactive gas in the event of an accidental rupture of the channeling. (France)

37849 NUCLEAR POWER PLANTS FOR DISTRICT HEATING. Kirvelae, K. (Ekono, Helsinki). Sahko; 45: No. 2, 87-91(Feb 1972).

The possibilities for using the components of normal condensing steam turbines to develop turbines suitable for nuclear district heating power plants are discussed. A relatively efficient solution is obtained by exchanging the low pressure casings for smaller ones, dimensioning the blading for the requirements of new operating conditions and by applying an asymmetric arrangement to tandem casings. The power production capacity is reduced by about one third of the equivalent condensing plant capacity, but as a compensation, about a seven-fold quantity of energy is obtained for district heating. (Finland)

37850 HYBRID SIMULATION OF A SODIUM-HEATED STEAM GENERATOR. ten Wolde, D. G.; van Wouw, H. J. Ingenieur (Utrecht); 83: W57-68(7 May 1971). (In Dutch).

A method is described for simulating the dynamic behavior of a sodium-heated once-through steam generator by means of a hybrid computer. Emphasis is placed on the background of the simulation, the choice of the hybrid C.S.D.T.-method and the application of such a method in practice. A general description of the program is included and some results are shown. (auth)

Commercial Power Reactors

37851 (FIND–50277(5-72)) FIND: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 25 May 1972. 30p. (FIND–50278(5-72)). Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

37852 (FIND–50363(5-72)) FIND: FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Revision 1. Smith, James G. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 31 May 1972. 21p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (J.M.J.)

37853 CONSTRUCTION PROGRAM OF Oi NUCLEAR POWER PLANT. Yoshimoto, M. (Kansai Electric Power Co. Inc., Osaka). Genshiryoku Kogyo; 17: No. 12, 44-9(Dec 1971). (In Japanese).

A nuclear power plant with two pressurized water type reactors to be constructed at Oi town in Fukui prefecture is described. The construction program is presented. Total thermal power of this plant is 3423 MW and finally 1175 MW(e) is generated. Design characteristics are listed. (Japan)

Physics and Core Engineering

37854 OPTIMIZATION STUDIES FOR A CIRENE REACTOR SYSTEM. PART 2. TECHNICAL AND ECONOMIC ASSESSMENT. Bozzola, S.; Lombardi, C.; Moro, C.; Zorzoli, G. B. (CISE, Milan). Energ. Nucl. (Milan); 19: No. 5, 295–316(May 1972).

Results of design calculations and economic evaluations for a few hundred 500 MW(e) CIRENE reactor systems are discussed following the step by step procedure adopted to carry on the work itself. The logical evolution of the optimization studies, which identified a narrow range of design features suited for a 500 MW(e) CIRENE reactor system, is described. (auth)

Coolant System

37855 (DOCKET-50213–141) HADDAM NECK PLANT, UNIT 1. Examination and Evaluation of Capsule F for the Connecticut Yankee Reactor Pressure-Vessel Surveillance Program. (Battelle Columbus Labs., Ohio). 30 Mar 1972. 164p. Dep. NTIS.

For Connecticut Yankee Atomic Power Co., Haddam.

37856 (DOCKET-50327–25) SEQUOYAH NUCLEAR PLANT, UNIT 1. Results of Inspection of Reactor Vessel Fabrication at Rotterdam Dockyard Company. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 17 May 1972. 13p. Dep. NTIS.

37857 (DOCKET-50338–43) NORTH ANNA POWER STATION, UNIT 1. Results of an Inspection of Reactor Vessel Fabrication. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 17 May 1972. 13p. Dep. NTIS.

Auxiliary Systems and Engineered Safeguards

37858 ORGANIZATION OF RADIATION MONITORING IN NUCLEAR POWER STATION. Il'khman, A. A.; Dedkov, V. M.; Romanov, A. N. At. Energ. (USSR); 32: No. 2, 107-9(Feb 1972). (In Russian).

Radiation monitoring systems for a nuclear power station are described. The functional structure of the monitoring system is simplified by including it as a separate subsystem of the complex control system of the nuclear power station. (auth)

Operation and Economics

37859 (DOCKET-50003–112) INDIAN POINT STATION, UNIT 1. Semiannual Operations Report No. 19, October 1, 1971–March 31, 1972. (Consolidated Edison Co. of New York, Inc., New York). 31 May 1972. 68p. Dep. NTIS.

37860 (DOCKET-50003–113) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change 44. (Directorate of Licensing (AEC), Washington, D. C.). 18 May 1972. 16p. Dep. NTIS.

Revised technical specifications are presented concerning primary cooling system surveillance requirements. (D.C.C.)

37861 (DOCKET-50029–182) YANKEE NUCLEAR POWER STATION. Operation Report No. 136, April 1972. (Yankee Atomic Electric Co., Westboro, Mass.). 22 May 1972. 8p. Dep. NTIS.

37862 (DOCKET-50155–113) BIG ROCK POINT NUCLEAR PLANT. Corrective Action Taken with Regard to Failures to Withdraw Control Rods. (Consumers Power Co., Jackson, Mich.). 25 Apr 1972. 3p. Dep. NTIS.

37863 (DOCKET-50206–156) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Unit Trip and Subsequent Activation of Safety Injection Equipment. (Southern California Edison Co., Rosemead, Calif.). 30 May 1972. 8p. Dep. NTIS.

37864 (DOCKET-50213–140) HADDAM NECK PLANT, UNIT 1. Operations Report 72-4. (Connecticut Yankee Atomic Power Co., Hartford). 22 May 1972. 13p. (NYO–3144–71). Dep. NTIS.

37865 (DOCKET-50219–188) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Observed Change in Stack Gas Activity During Station Start-Up. (Jersey Central Power and Light Co., Morristown, N. J.). 30 May 1972. 2p. Dep. NTIS.

37866 (DOCKET-50219–189) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Fuel Assembly Loading Error. (Jersey Central Power and Light Co., Morristown, N. J.). 24 May 1972. 2p. Dep. NTIS.

37867 (DOCKET-50219–190) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Torus Baffles, Inspection and Repair Report. (Jersey Central Power and Light Co., Morristown, N. J.). May 1972. 18p. Dep. NTIS.

37868 (DOCKET-50219–193) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Authorization to Conduct Low Power Physics Tests with Reactor Head Removed. (Directorate of Licensing (AEC), Washington, D. C.). 26 May 1972. 2p. Dep. NTIS.

37869 (DOCKET-50220–95) NINE MILE POINT NUCLEAR STATION, UNIT 1. Problem with Electromatic Relief Valves Disclosed on Annual Inspection. (Niagara Mohawk Power Corp., Lycoming, N. Y.). 2 Jun 1972. 3p. Dep. NTIS.

37870 (DOCKET-50237–236) DRESDEN NUCLEAR POWER STATION, UNIT 2. Certain Above Ground Tanks at Radwaste Contained Total Activities Above 0.7 Ci Limit. (Commonwealth Edison Co., Chicago, Ill.). 25 May 1972. 2p. Dep. NTIS.

37871 (DOCKET-50237–237) DRESDEN NUCLEAR POWER STATION, UNIT 2. Failure of Reactor Protection Limit Switch of No. 2 Turbine Stop Valve. (Commonwealth Edison Co., Morris, Ill. (USA)). 30 May 1972. 1p. Dep. NTIS.

37872 (DOCKET-50237–239) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Steps Taken to Correct Item of Noncompliance in Letter Dated May 9, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 31 May 1972. 5p. (DOCKET-50249–137). Dep. NTIS.

Additional information is presented concerning the reactor mode switch being locked in the "refuel" position during core alterations. (D.C.C.)

37873 (DOCKET-50237–240) DRESDEN NUCLEAR POWER STATION, UNIT 2. Limit Switch Failed to Operate on Test. (Commonwealth Edison Co., Chicago, Ill.). 6 Jun 1972. 2p. Dep. NTIS.

The failure of a limit switch to operate during a test of number 2 turbine stop valve is described. Corrective actions are presented. (D.C.C.)

37874 (DOCKET-50249-135) DRESDEN NUCLEAR POWER STATION, UNIT 3. HPCI Initiating System Would Not Reset From Control Room. (Division of Reactor Licensing (AEC), Washington, D. C.). 22 May 1972. 1p. Dep. NTIS.

37875 (DOCKET-50249-136) DRESDEN NUCLEAR POWER STATION, UNIT 3. Failure of High Pressure Coolant Injection Turbine to Reset. (Commonwealth Edison Co., Chicago, Ill.). 25 May 1972. 2p. Dep. NTIS.

37876 (DOCKET-50249-138) DRESDEN NUCLEAR POWER STATION, UNIT 3. Pressurization of Primary Containment on May 4, 1972. (Commonwealth Edison Co., Chicago, Ill.). 3 Jun 1972. 14p. Dep. NTIS.

37877 (DOCKET-50255-85) PALISADES PLANT. Malfunctions of Check Valve and Motor Operator of Safety Injection Valve. (Consumers Power Co., Jackson, Mich.). 22 May 1972. 2p. Dep. NTIS.

37878 (DOCKET-50255-86) PALISADES PLANT. Incidents Involving 1-2 Start-Up Transformer Protective Relays and Emergency Diesel Generator No. 1-1. (Consumers Power Co., Jackson, Mich.). 26 May 1972. 3p. Dep. NTIS.

37879 (DOCKET-50261-93) H. B. ROBINSON UNIT 2. Routine Operating Report No. 3, October 1, 1971–March 31, 1972. (Carolina Power and Light Co., Raleigh, N. C.). 23 May 1972. 96p. Dep. NTIS.

37880 (DOCKET-50261-94) H. B. ROBINSON UNIT 2. Environmental Monitoring Report, October 1, 1971–March 31, 1972. (Eberline Instrument Corp., Santa Fe, N. Mex. Dept. of Nuclear Sciences). 23 May 1972. 46p. Dep. NTIS.

For Carolina Power and Light Co., Raleigh, N. C.

37881 (DOCKET-50263-123) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Reporting of Low APRM Gain Setting. (Northern States Power Co., Minneapolis, Minn.). 25 May 1972. 2p. Dep. NTIS.

37882 (DOCKET-50263-125) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Momentary Opening of "A" Reactor Safety Valve. (Northern States Power Co., Minneapolis, Minn.). 2 Jun 1972. 4p. Dep. NTIS

37883 (DOCKET-50265-78) QUAD-CITIES STATION, UNIT 2. High Pressure Coolant Injection System Turbine Turning Gear Motor Failure. (Commonwealth Edison Co., Cordova, Ill.). 24 May 1972. 2p. Dep. NTIS.

37884 (DOCKET-50280-76) SURRY POWER STATION, UNIT 1. Facility Operating License and Technical Specifications. (Directorate of Licensing (AEC), Washington, D. C.). 25 May 1972. 322p. Dep. NTIS.

37885 (DOCKET-50298-36) COOPER NUCLEAR STATION. License Application. (Consumers Public Power District, Columbus, Nebr.). 26 Jul 1967. 143p. Dep. NTIS.

Financial data on the owners of the Cooper Power Reactor are presented. The 1966 Annual Reports for the Consumers Public Power District and the Iowa Power and Light Company are included. (D.C.C.)

37886 (DOCKET-50409-1) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for April 1972. (Dairyland Power Cooperative, La Crosse, Wis.). Apr 1972. Contract AT(11-1)-851. 25p. (DPC-851-42). Dep. NTIS.

37887 (WASH-1203-71) OPERATING HISTORY OF U. S. NUCLEAR POWER REACTORS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 1971. 64p. GPO $0.60.

The operating history of U.S. nuclear power plants through December 31, 1971 is reviewed. Included are those nuclear reactor facilities which produce electricity, even if in token amounts, or which are part of a development program concerned with the generation of electricity through the use of a nuclear reactor as a heat source. The information presented is based on data furnished by facility operators. The charts are plotted in terms of cumulative thermal energy as a function of time. Since only those shutdowns of five days or more are shown, the charts do not give a detailed history of plant operation. The data presented in the tables shows the yearly gross generation of electricity for each U. S. nuclear plant and, for civilian power plants, information on reactor availability and plant capacity factor. (auth)

37888 WORLD SOURCES OF ENERGY IN THE LATE TWENTIETH CENTURY. Hinton, Christopher. Graham Clark Lecture 1971. London; Council of Engineering Institutions (1971). 23p. 37 pence.

Total energy demand is predicted to increase globally by 5% and energy resources will be able to cope with this rise. However, coal will become less important. The competition between oil and nuclear power in fixed land-based power plants is described. (auth)

37889 OUTLINE OF JAPAN'S REACTOR LICENSING REGULATIONS. At. Jap.; 15: No. 10, 15-18(Oct 1971).

Licensing procedures for construction and operation of nuclear power plants in Japan are explained. Upon receipt of application, AEC and CERS examine the safety aspects of projected reactor plants. The result is submitted to the Prime Minister who then decides on licensing permission. Subsequently, during construction and operation, Electric Enterprise Law and Nuclear Reactor Regulation Law are enforced. The CERS examines siting, equipment, etc. The members are selected formally by the Prime Minister. (Japan)

37890 OPERATION RECORDS ON THE TSURUGA POWER STATION OF JAPC. Asada, Chuichi (Japan Atomic Power Co., Tokyo). Karyoku Hatsuden; 22: No. 10, 1114-26(Oct 1971). (In Japanese).

The Tsuruga power station is the second nuclear power plant in Japan, it employs a boiling water reactor with electric output of 357 MW. It was completed in March 1970. Operation records for the past year, especially first periodic inspection carried out in the fall of 1970, are described. Various tests and also minor accidents in the reactor and turbine systems during the first year are reviewed. Procedures of the first periodic inspection are explained on containment vessel, reactor pressure vessel, fuel, recirculation pumps, main steam-shut-off valves, reactor control rod drive, and neutron instrumentation. Pressure boundary of the Tsuruga plant, procedures and personnel for its inspection and radiation level involved are explained. (Japan)

37891 DEMONSTRATION OF HORIZONTAL VIBRATIONS OF THE CORE CONTAINER IN NEUTRON FLUX NOISE. Bastl, W. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.); Wach, D.; Dio, W. H.; Haas, W. Atomwirt., Atomtech.; 17: No. 5, 263-4(May 1972). (In German).

At the nuclear power plant Stade simultaneous measurements were performed with respect to neutron flux noise and horizontal vibrations of the core container relative to the pressure vessel. Under the concept that pressure vessel and core container formed a coupled 2-mass system, the relative motion of the core could be demonstrated. The maximum amplitude of vibrations occurred at 13 cycles/sec and amounted to 0.17 mm. In the neutron noise recordings, a corresponding peak was found. (10 references) (H.B.G.)

Safety and Siting

37892 (DOCKET-1151-53) ELK RIVER REACTOR. Status Report, February 1, 1972–May 1, 1972. (United Power Association, Elk River, Minn. (USA)). 15 May 1972. 12p. Dep. NTIS.

37893 (DOCKET-1151-54) ELK RIVER REACTOR. Order Authorizing Dismantling of Facility. (Directorate of Licensing (AEC), Washington, D. C.). 5 Jun 1972. 3p. Dep. NTIS.

37894 (DOCKET-1154-6) BONUS NUCLEAR POWER PLANT. Order Terminating Operating Authorization. (Directorate of Licensing (AEC), Washington, D. C.). 5 Jun 1972. 4p. Dep. NTIS.

37895 (DOCKET-1155-170) LA CROSSE BOILING WATER REACTOR. Application for Conversion of Provisional Operating Authorization to a Provisional Operating License. (Dairyland Power Cooperative, La Crosse, Wis.). 22 May 1972. 134p. Dep. NTIS.

37896 (DOCKET-50003-111) INDIAN POINT STATION, UNIT 1. Technical Specifications, Proposed Change and Report on Wind Tunnel Test of Gas Dispersion. (Consolidated Edison Co. of New York, Inc., New York). 25 May 1972. 65p. Dep. NTIS.

37897 (DOCKET-50010-108) DRESDEN NUCLEAR POWER STATION, UNIT 1. Is Being Base Loaded at Reduced Loads as of May 18, 1972. (Commonwealth Edison Co., Chicago, Ill.). 23 May 1972. 1p. Dep. NTIS.

37898 (DOCKET-50016-158) ENRICO FERMI ATOMIC POWER PLANT. Steps Taken to Correct Item of Noncompliance Described in Letter of April 18, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 17 May 1972. 6p. Dep. NTIS.

Acknowledgment of failure to perform a weekly test of the diesel generator is presented. Actions taken to prevent reoccurrence are described. (D.C.C.)

37899 (DOCKET-50029–183) YANKEE NUCLEAR POWER STATION. Additional Information Relative to Code Classification. (Yankee Atomic Electric Co., Westboro, Mass.). 1 Jun 1972. 1p. Dep. NTIS.

Additional information is presented concerning code classification of the emergency core cooling system and recirculation system. (D.C.C.)

37900 (DOCKET-50029–184) YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 100. (Directorate of Licensing (AEC), Washington, D. C.). 18 May 1972. 4p. Dep. NTIS.

Revised technical specifications are presented concerning a modified control rod withdrawal program for Core 10. The program modification is needed due to an inoperable control rod. (D.C.C.)

37901 (DOCKET-50133–86) HUMBOLDT BAY POWER PLANT, UNIT 3. Additional Meteorological Data. (Pacific Gas and Electric Co., San Francisco, Calif.). 2 Jun 1972. 10p. Dep. NTIS.

37902 (DOCKET-50133–87) HUMBOLDT BAY POWER PLANT, UNIT 3. Technical Specifications, Change 38. (Directorate of Licensing (AEC), Washington, D. C.). 5 Jun 1972. 9p. Dep. NTIS.

Revised technical specifications are presented concerning the operational testing requirements for engineered safeguards. (D.C.C.)

37903 (DOCKET-50146–109) SAXTON NUCLEAR EXPERIMENTAL REACTOR PROJECT. Technical Specifications, Change Request 50, Amendment 1. (Saxton Nuclear Experimental Corp., Pa.). 30 May 1972. 24p. Dep. NTIS.

Revised technical specifications are presented concerning decommissioning of the Saxton Power Reactor. (D.C.C.)

37904 (DOCKET-50171–103) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Moisture Detectors. (Philadelphia Electric Co., Pa.). 22 May 1972. 3p. Dep. NTIS.

37905 (DOCKET-50219–187) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Facility Description and Safety Analysis Report, Amendment 69 and Technical Specifications Change Request 12. (Jersey Central Power and Light Co., Morristown, N. J.). 26 May 1972. 42p. Dep. NTIS.

Transient analysis for Cycle 2 core is presented for power levels up to 1930 MW(t). (D.C.C.)

37906 (DOCKET-50219–191) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change Request 11. (Jersey Central Power and Light Co., Morristown, N. J.). 17 May 1972. 4p. Dep. NTIS.

Revised technical specifications are presented concerning the limiting conditions for operation of the containment spray system. The change in the specifications removes a personnel hazard associated with possible contact with toxic chromated water should the system be actuated when personnel are in the primary containment. (D.C.C.)

37907 (DOCKET-50219–192) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change 11. (Directorate of Licensing (AEC), Washington, D. C.). 18 May 1972. 2p. Dep. NTIS.

Revised technical specifications are presented concerning operation requirements for the containment spray system. (D.C.C.)

37908 (DOCKET-50220–96) NINE MILE POINT NUCLEAR STATION, UNIT 1. Technical Specifications, Change 6. (Directorate of Licensing (AEC), Washington, D. C.). 18 May 1972. 5p. Dep. NTIS.

Revised technical specifications are presented concerning the lowering of set points for solenoid-actuated pressure relief valves and the lowering of the set point for actuation of the emergency cooling condensers. (D.C.C.)

37909 (DOCKET-50237–238) DRESDEN NUCLEAR POWER STATION, UNIT 2. Results of Torus Inspection. (Commonwealth Edison Co., Chicago, Ill.). 31 May 1972. 2p. Dep. NTIS.

37910 (DOCKET-50244–101) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Summary of Results, Safety Injection Accumulator Blowdown Tests. (Westinghouse Electric Corp., Pittsburgh, Pa.). Sep 1969. 21p. (WCAP–7849). Dep. NTIS.

37911 (DOCKET-50245–131) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Change 4. (Directorate of Licensing (AEC), Washington, D. C.). 24 May 1972. 8p. Dep. NTIS.

Revised technical specifications are presented concerning the use by personnel of respiratory protective equipment. (D.C.C.)

37912 (DOCKET-50245–132) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1. Expiration Date of Provisional Operating License Extended to October 7, 1973. (Directorate of Licensing (AEC), Washington, D. C.). 5 Jun 1972. 2p. Dep. NTIS.

37913 (DOCKET-50247–73) INDIAN POINT NUCLEAR GENERATING UNIT 2. Report, WNET–103: Evaluation of Ultrasonic Indication in Steam Generator No. 21. (Westinghouse Electric Corp., Tampa, Fla.). 12 May 1972. 61p. Dep. NTIS.

During a field modification of the Indian Point Power Reactor Unit 2 steam generators, an ultrasonic test was made to verify pre-service inspection results from tests conducted prior to the modification. As a result of some deviation between the tests, further testing and analysis was done. It is concluded that the deviations observed are within the tolerances of the ultrasonic techniques, that the sonic indication is within ASME Section III limits for slag in welds, and that the slag does not present a risk from either fatigue or fracture mechanics considerations. (10 references) (auth)

37914 (DOCKET-50250–82) TURKEY POINT PLANT, UNITS 3 AND 4. Survey of the Terrestrial Ecology of the Turkey Point Area. (Environmental Engineering, Inc., Gainesville, Fla. (USA)). 25 May 1972. 118p. (DOCKET-50251–68). Dep. NTIS.

For Florida Power and Light Co.

Additional information on site biota is presented. The effectiveness of fish barriers for the cooling system water intake is studied. (27 references) (D.C.C.)

37915 (DOCKET-50254–93) QUAD-CITIES STATION, UNITS 1 AND 2. Additional Information Concerning Structural Integrity of Tori. (Commonwealth Edison Co., Chicago, Ill.). 31 May 1972. 2p. (DOCKET-50265–79). Dep. NTIS.

37916 (DOCKET-50255–87) PALISADES PLANT. Steps Taken to Correct Items of Apparent Noncompliance Listed in Letter Dated May 3, 1972. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 25 May 1972. 6p. Dep. NTIS.

Additional information is presented concerning the qualifications of welders involved with the welding of floor drain piping. (D.C.C.)

37917 (DOCKET-50259–51) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 31. (Tennessee Valley Authority, Chattanooga). 24 May 1972. 195p. (DOCKET-50260–48; DOCKET-50296–45). Dep. NTIS.

Revised and additional information is presented concerning earthquake stress design requirements for equipment and structures and the site emergency plan. (D.C.C.)

37918 (DOCKET-50261–92) H. B. ROBINSON UNIT 2. Technical Specification Change Request, Part Length Rods. (Carolina Power and Light Co., Raleigh, N. C.). 18 May 1972. 8p. Dep. NTIS.

Revised technical specifications are presented concerning operations with either 4 or 8 part-length control rods. (D.C.C.)

37919 (DOCKET-50261–95) H. B. ROBINSON UNIT 2. Steps Taken to Correct Items of Apparent Noncompliance Listed in Letter Dated March 29, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 23 May 1972. 6p. Dep. NTIS.

Measures taken to strengthen the H. B. Robinson Plant radioactive effluent accountability program are described. (H.D.R.)

37920 (DOCKET-50261–96) H. B. ROBINSON UNIT 2. Technical Specifications, Proposed Changes with Regard to Operation of Company Nuclear Safety Committee. (Carolina Power and Light Co., Raleigh, N. C.). 17 May 1972. 7p. Dep. NTIS.

Revised information is presented concerning responsibilities and authority of the Company Nuclear Safety Committee. (D.C.C.)

37921 (DOCKET-50263–122) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). May 1972. 162p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Geological, hydrological, and meteorological data for the reactor site are included. A listing of site biota is presented. Cost-benefit analysis of reactor operations is also presented. (D.C.C.)

37922 (DOCKET-50267-44) FORT ST. VRAIN NUCLEAR GENERATING STATION. Final Safety Analysis Report, Amendment 25 and Technical Specifications. (Public Service Co. of Colorado, Denver). 15 May 1972. 577p. Dep. NTIS.

The Fort St. Vrain application for a construction permit and a class 104 nuclear materials license is amended by submission of revised answers to USAEC questions, revised pages for the Final Safety Analysis Report, and the 1971 annual report on the environmental radiation surveillance program for the site. The Technical Specifications governing operation of the facility are also included. (H.D.R.)

37923 (DOCKET-50269-54) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Amendment 32. (Duke Power Co., Charlotte, N. C.). 30 May 1972. 109p. (DOCKET-50270-44; DOCKET-50287-39). Dep. NTIS.

Revised design parameters of the Oconee Power Reactor Units 1, 2, and 3 are presented. Included also are additional data on the reactors requested by the Division of Reactor Licensing. (D.C.C.)

37924 (DOCKET-50269-55) OCONEE NUCLEAR STATION, UNIT 1. Steps Taken with Respect to Items in Letters Dated January 21, 1972 and March 16, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 12 May 1972. 13p. Dep. NTIS.

Measures taken to correct inadequate quality assurance testing and inspection procedures are described. (H.D.R.)

37925 (DOCKET-50277-38) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Environmental Report Operating License Stage, Supplement 2. (Philadelphia Electric Co., Pa.). 25 May 1972. 54p. (DOCKET-50278-44). Dep. NTIS.

Additional information is presented concerning chemical, radioactive, and thermal discharges from the reactors, the environmental monitoring program, and the cost-benefit analysis for reactor operations. (D.C.C.)

37926 (DOCKET-50280-75) SURRY POWER STATION, UNIT 1. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). May 1972. 288p. Dep. NTIS.

37927 (DOCKET-50285-65) FORT CALHOUN STATION, UNIT 1. Final Safety Analysis Report, Supplement 17. (Omaha Public Power District, Nebr.). 30 May 1972. 64p. Dep. NTIS.

Revised and additional information is presented concerning cooling system pumps and piping, control element assemblies, and performance of the emergency core cooling system. (D.C.C.)

37928 (DOCKET-50286-44) INDIAN POINT NUCLEAR GENERATING UNIT 3. Action Taken to Correct Items of Noncompliance Found on Inspection January 27–28, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 2 May 1972. 4p. Dep. NTIS.

Additional information is presented concerning weld rod traceability procedures for field welding of coolant piping. (D.C.C.)

37929 (DOCKET-50289-57) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Action Taken to Correct Item of Nonconformance Found on Inspection of March 9, 1972. (Division of Compliance, Newark, N. J. Region I). 18 May 1972. 5p. (DOCKET-50320-29). Dep. NTIS.

Correct color coding procedures for electrical wiring installation are described. (D.C.C.)

37930 (DOCKET-50289-58) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Information on Concrete of Ring Girder of Containment Building. (Metropolitan Edison Co., Reading, Pa.). 31 May 1972. 10p. Dep. NTIS.

37931 (DOCKET-50298-37) COOPER NUCLEAR STATION. Construction Permit Power Reactor, CPPR-42, Issued. (Division of Reactor Licensing (AEC), Washington, D. C.). 13 Jun 1968. 16p. Dep. NTIS.

37932 (DOCKET-50298-38) COOPER NUCLEAR STATION. Hydrology and Geology. (Consumers Public Power District, Columbus, Nebr.). 6 Mar 1968. 2p. Dep. NTIS.

37933 (DOCKET-50298-39) COOPER NUCLEAR STATION. Summary Report on Progress Carried Out in Response to Recommendations by Fish and Wildlife Service. (Consumers Public Power District, Columbus, Nebr.). 14 Oct 1969. 2p. Dep. NTIS.

The suggested pre-operational radiation monitoring program for the reactor site is described. The pre-operational study of site ecology is discussed. (D.C.C.)

37934 (DOCKET-50298-40) COOPER NUCLEAR STATION. Application for Extension of Completion Date to February 1, 1973. (Nebraska Public Power District, Columbus). 7 Dec 1971. 3p. Dep. NTIS.

37935 (DOCKET-50298-41) COOPER NUCLEAR STATION. Final Safety Analysis Report, Responses to Questions. (Nebraska Public Power District, Columbus). 6 Apr 1972. 23p. Dep. NTIS.

Requested additional information is presented concerning chemical and radioactive discharges from the reactor. (D.C.C.)

37936 (DOCKET-50298-42) COOPER NUCLEAR STATION. Adequacy of the Structural Criteria. (Newmark (Nathan M.), Urbana, Ill.). 19 Feb 1968. 11p. Dep. NTIS.

37937 (DOCKET-50301-58) POINT BEACH NUCLEAR PLANT, UNIT 2. Facility Operating License, Amendment 1 and Technical Specifications. (Directorate of Licensing (AEC), Washington, D. C.). 25 May 1972. 254p. Dep. NTIS.

37938 (DOCKET-50302-46) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Order Extending Completion Date to September 30, 1974. (Directorate of Licensing (AEC), Washington, D. C.). 1 Jun 1972. 2p. Dep. NTIS.

37939 (DOCKET-50302-47) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Environmental Status Report, July–September 1970. (Florida Power Corp., St. Petersburg). 10 May 1972. 68p. Dep. NTIS.

37940 (DOCKET-50302-48) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Environmental Status Report, July–December 1971. (Florida Power Corp., St. Petersburg). 10 May 1972. 104p. Dep. NTIS.

37941 (DOCKET-50305-41) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 18, Errata. (Wisconsin Public Service Corp., Green Bay). 2 Jun 1972. 12p. Dep. NTIS.

Corrected information is presented concerning design parameters and operations aspects for the reactor. (D.C.C.)

37942 (DOCKET-50309-59) MAINE YANKEE ATOMIC POWER STATION. Report on Preliminary Experiments on the Critical Thermal Maxima for the Bloodworm (Glycera Dibranchiata) and the Sandworm (Nereis Virens). (Maine Yankee Atomic Power Co., Westboro, Mass.). 26 May 1972. 8p. Dep. NTIS.

37943 (DOCKET-50313-42) ARKANSAS NUCLEAR ONE, UNITS 1 AND 2. Arkansas Environmental Radiation Surveillance Program, Revised April 28, 1972. (Arkansas Dept. of Health, Little Rock (USA). Bureau of Environmental Health Services). 19 May 1972. 18p. (DOCKET-50368-30). Dep. NTIS.

37944 (DOCKET-50315-64) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 23. (Indiana and Michigan Power Co., New York). 23 May 1972. 149p. (DOCKET-50316-64). Dep. NTIS.

Performance evaluation for the ice condenser containment system is presented. (D.C.C.)

37945 (DOCKET-50317-47) CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 1. Action to be Taken to Correct Item of Noncompliance and Item of Nonconformance Found on Inspection of March 6–8, 1972. (Division of Compliance (AEC), Newark, N. J. Region I). 4 May 1972. 7p. Dep. NTIS.

Additional information is presented concerning the required quality assurance program for the pre-operational test program and training requirements for instrument and control repairmen. (D.C.C.)

37946 (DOCKET-50317-48) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Documents Pertaining to the Calvert Cliffs Environmental Report. (Baltimore Gas and Electric Co., Md.). 30 May 1972. 374p. (DOCKET-50318-46). Dep. NTIS.

Hydrological and meteorological data for the reactor site are presented. Information concerning site biota is included. (D.C.C.)

37947 (DOCKET-50317-49) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 21. (Baltimore Gas and Electric Co., Md.). 31 May 1972. 212p. (DOCKET-50318-47). Dep. NTIS.

Revised design parameters of the Calvert Cliffs Power Reactor Units 1 and 2 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

37948 (DOCKET-50317-50) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Additional Portions of Site Emergency Plan, Rev. 0. (Baltimore Gas and Electric Co., Md.). 9 Jun 1972. 62p. (DOCKET-50318-48). Dep. NTIS.

37949 (DOCKET-50321-42) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 16. (Georgia Power Co., Atlanta). 29 May 1972. 378p. Dep. NTIS.

Revised design parameters of the Edwin I. Hatch Power Reactor Unit I are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

37950 (DOCKET-50322-26) SHOREHAM NUCLEAR POWER STATION, UNIT 1. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). 6 Jun 1972. 374p. Dep. NTIS.

Information concerning radioactive and thermal discharges from the reactor is presented. The effects of reactor operations on the environment are analyzed. Geological, hydrological, and meteorological data for the reactor site are included. A listing of site biota is also included. Cost-benefit analysis for reactor operation is presented. (D.C.C.)

37951 (DOCKET-50324-38) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Environmental Report, Amendment 1. (Carolina Power and Light Co., Raleigh, N. C.). 5 Jun 1972. 124p. (DOCKET-50325-39). Dep. NTIS.

Information concerning chemical and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Estimated costs for reactor systems are presented. Information on biota for the reactor site is included. (D.C.C.)

37952 (DOCKET-50327-26) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Apparent Noncompliance Noted in Letter Dated March 13, 1972. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 17 May 1972. 16p. (DOCKET-50328-24). Dep. NTIS.

Quality assurance aspects of containment structure concreting, receipt, inspection and storage of major components, and programs for the design, purchasing, erection, inspection and testing of electrical/instrumentation and piping systems are discussed. (H.D.R.)

37953 (DOCKET-50331-46) DUANE ARNOLD ENERGY CENTER. Final Safety Analysis Report, Amendment 1, Supplement. (Iowa Electric Light and Power Co., Cedar Rapids). 6 Jun 1972. 3p. Dep. NTIS.

Additional information is presented concerning the fire protection system for the emergency diesel generator. (D.C.C.)

37954 (DOCKET-50333-45) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Action Taken to Correct Items of Noncompliance Found on Inspection of January 25-27, 1972. (Division of Compliance, Newark, N. J. Region I). 18 May 1972. 6p. Dep. NTIS.

Additional information is presented concerning the use of ferrous tools and materials in contact with the stainless steel lines of the spent fuel pool and the inspection methods used for the core spray valves. (D.C.C.)

37955 (DOCKET-50333-46) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Supplementary Protection for Primary Containment in Vicinity of High Stress Areas. (Power Authority of the State of New York). 23 May 1972. 2p. Dep. NTIS.

Additional motion restraining devices for piping systems near the primary containment structure are described. (D.C.C.)

37956 (DOCKET-50335-27) HUTCHINSON ISLAND PLANT, UNIT 1. Environmental Report, Supplement 3. (Florida Power and Light Co.). 30 May 1972. 45p. Dep. NTIS.

Requested additional information is presented on radioactive and thermal effluents from the reactor, site biota, environmental aspects of transmission lines, and cost-benefit analysis. (D.C.C.)

37957 (DOCKET-50338-44) NORTH ANNA POWER STATION, UNITS 1 AND 2. Notice That Minor Changes will be Requested in Power Ratings in Final Safety Analysis Report. (Virginia Electric and Power Co., Richmond). 6 Jun 1972. 2p. (DOCKET-50339-41). Dep. NTIS.

37958 (DOCKET-50352-26) LIMERICK GENERATING STATION, UNITS 1 AND 2. Applicant's Environmental Report, Construction Permit Stage (Revised). (Philadelphia Electric Co., Pa.). 26 May 1972. 1050p. (DOCKET-50353-26). Dep. NTIS.

Information concerning chemical, radioactive, and thermal discharges from the reactors is presented. The effects of reactor operations on the environment are analyzed. Geological, hydrological, and meteorological data on the reactor site are presented. Information concerning biota for the site is included. Cost-benefit analysis of reactor operation is also included. (D.C.C.)

37959 (DOCKET-50363-26) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Preliminary Safety Analysis Report, Amendment 16. (Jersey Central Power and Light Co., Morristown, N. J.). 26 May 1972. 157p. Dep. NTIS.

Revised and additional data are presented on the Forked River Unit 1 fuel rods, safety injection tank pressure, and seismology and geology of the site. (H.D.R.)

37960 (DOCKET-50373-20) LA SALLE COUNTY STATION, UNITS 1 AND 2. Steps Taken to Correct Inconsistencies Between La Salle Quality Assurance Program and Certain Sections of Quality Assurance Manual. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 15 May 1972. 9p. (DOCKET-50374-20). Dep. NTIS.

37961 (DOCKET-50395-19) VIRGIL C. SUMMER NUCLEAR STATION. Preliminary Safety Analysis Report, Amendment 8. (South Carolina Electric and Gas Co., Columbia). 25 May 1972. 305p. Dep. NTIS.

Revised and additional data are presented concerning design parameters and operations aspects of the reactor. (D.C.C.)

37962 (DOCKET-50397-17) HANFORD NO. 2 NUCLEAR POWER PLANT. Preliminary Safety Analysis Report, Amendment 6. (Washington Public Power Supply System, Richland). 19 May 1972. 339p. Dep. NTIS.

Revised design parameters of the Hanford Power Reactor Unit 2 are presented. Included also are additional data on the reactor requested by the Division of Reactor Licensing. (D.C.C.)

37963 (WERLV-1) HUMBOLDT BAY NUCLEAR POWER PLANT SURVEY, MARCH THROUGH MAY 1971. Andrews, Vernon E.; Horton, Thomas R. (Western Environmental Research Lab., Las Vegas, Nev.). Apr 1972. 36p. Dep. NTIS.

A pilot study was conducted to evaluate the use of aerial surveillance techniques in tracking and sampling of gaseous effluent from nuclear power plants. Data derived from such measurements would be useful in measuring peak environmental exposures and in determining the effects of local terrain and meteorology on diffusion of the airborne effluent. Exposure rates and concentrations measured during coordinated aerial and ground monitoring for the Humboldt Bay Power Reactor are compared to predicted exposure rates and concentrations based on measured release rates and observed meteorology. Plume centerline concentrations and exposure rates, measured from the aircraft, agreed within a factor of two with predicted values. Ground level concentrations, based on observed meteorology at the power plant, were about an order of magnitude below predictions, apparently due mostly to terrain effects. (auth)

37964 SAFETY STUDY ON NUCLEAR POWER PLANTS BY NSRA. At. Jap.; 15: No. 9, 5-8(Sep 1971).

The Nuclear Safety Research Association (NSRA) was established in July 1966 by JAIF for research on nuclear safety in Japan. Its activities are in relation to safety of power plants, especially light-water reactors, and prevention of radiation hazards. Achievements in nuclear safety research by the NSRA are described. (Japan)

37965 SAFETY ASSESSMENT FOR ADDITION OF No. 5 REACTOR AT FUKUSHIMA NUCLEAR POWER STATION OF TOKYO ELECTRIC POWER COMPANY. Genshiryoku Iinkai Geppo; 16: No. 8, 24-34(Aug 1971). (In Japanese).

The safety assessment for addition of No. 5 reactor includes: alteration in installation (the addition of No. 5 reactor), safety design and safety countermeasures, radiation exposure evaluation during normal operation, investigation of conceivable faults, misoperation and accidents, hazard evaluation in case of major accidents and hypothetical accidents, and judgement on technical ability of applicant. (Japan)

Steam and Power Conversion System

37966 900 MW POWER PLANT ISAR WITH AEG BOILING WATER REACTOR. Baumgartl, B. J.; von Braunmuehl, H. (AEG-Telefunken, Frankfurt am Main). Atomwirt., Atomtech.; 17: No. 5, 269-73(May 1972). (In German).

The boiling water reactor of the nuclear power plant Isar is similar with the reactor of Philippsburg-1. Improvements concerning both internal axial pumps and core design are described. Additional improvements and modifications concerning the water steam circuit as well as the transformer station are discussed. Details of the power plant are described. (H.B.G.)

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 36001 and 36042.

37967 (AI-AEC-13023) SNAP REACTOR PROGRAMS PROGRESS REPORT, NOVEMBER 1971–JANUARY 1972. (Atomics International, Canoga Park, Calif.). 15 Apr 1972. Contract AT(04-3)-701. 103p. Dep. NTIS.

The physics measurements for the SPF Zirconium Hydride Reactor are presented. The design power level will be 300 kW(t), with an outlet coolant temperature of 1200°F. Heat transfer and hydraulic tests in support of the SPF reactor are described. The development of the control drive components for the reactor is reviewed. Improvements in the technology of ZrH-type fuel-moderator elements are reviewed. The thermoelectric power-conversion subsystem for use with a ZrH reactor-thermoelectric space-power system is described. (auth)

37968 (DOCKET-50238–91) N. S. SAVANNAH. Operations Report, Semiannual, August 24, 1971–March 21, 1972. (Maritime Administration, Washington, D. C.). 24 Apr 1972. 10p. Dep. NTIS.

37969 (RCN–163) FUEL CYCLE COST CALCULATIONS FOR A 120,000 SHP PWR FOR SHIP PROPULSION. Dekker, N. H.; Nolson, D.; Slobben, J. (Reactor Centrum Nederland, Petten); Foggi, C.; Giacomazzi, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb 1972. 79p. (EUR–4798). Dep. NTIS (U. S. Sales Only).

A parametric study of the fuel cycle costs for a 120,000 shp PWR for ship propulsion is described. Variable parameters are: fuel pellet diameter, moderating ratio and refueling scheme. Minimum fuel cycle costs can be obtained at moderating ratios of about 2.2. Both fuel cycle costs and reactor control requirements favor the two batch core. (11 references) (auth)

Process Heat and Desalination Reactors

Refer also to abstract 36119.

37970 NUCLEAR HEATING PLANTS: POSSIBLE SOLUTION TO AIR-POLLUTION PROBLEMS AND HEATING OF SARAJEVO. Popovic, Aleksandar. Nukl. Energ.; 6: No. 1, 24-6(1970-71). (In Serbo-Croatian).

The economics are discussed of nuclear-fueled plants for heating, both with and without concomitant production of electricity. Costs of heating with various types of fuels—nuclear, oil, electrical, etc.—are tabulated for comparison. Belgian specialists were consulted and indicated the possibility of using nuclear reactors for such plants. Problems to be solved, as outlined by Yugoslavian workers, include decision on location of such plants and safety measures to be adopted. (TTT)

Research and Test Reactors

Refer also to abstracts 37738, 37802, and 37842.

37971 (AWRE-O–20/72) DESCRIPTION OF THE HORACE REACTOR II. Webster, N. W. (Atomic Weapons Research Establishment, Aldermaston (England)). Mar 1972. 33p. Dep. NTIS (U. S. Sales Only). UK 1.00 pound.

HORACE is a zero energy light water moderated reactor, which is run at a maximum power of 2 W. The reactor normally operates at ambient temperature but the design allows for heating the moderator up to 70°C for temperature coefficient studies. Its main function is to provide information on the physics characteristics of HERALD cores, including reactivity, control absorber calibration, flux distributions and the effect of rigs. Design parameters of the zero power reactor are presented. (auth)

37972 (DOCKET-50184–42) NATIONAL BUREAU OF STANDARDS REACTOR. Isotopic Concentration of Heavy Water Accidently Reduced to 96 Percent. (National Bureau of Standards, Washington, D. C.). 5 Jun 1972. 1p. Dep. NTIS.

37973 (DOCKET-50231–119) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Outer Containment Building Vacuum Breaker Valve Malfunction. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). 5 Jun 1972. 3p. Dep. NTIS.

37974 (EURFNR–1005) INVESTIGATION OF REACTOR PHYSICS PROPERTIES OF THE SNEAK 3A-2 CORE IN THE FAST THERMAL REACTOR STARK, ASSEMBLY 6. Meister, H. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Dec 1971. 90p. (KFK–1539). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

Some of the reactor physics investigations carried out in the fast critical facility SNEAK, Assembly 3A-2, were repeated in the coupled fast-thermal reactor STARK whose central fast zone was loaded with the same core composition. The experimental program comprised measurements of differential neutron spectra, reaction rate ratios, reactivity worths of material samples and Doppler sample measurements at core center. For some reaction rates the fine structure within the lattice cell as well as macroscopic traverses have been determined. The experimental data are compared with the SNEAK 3A-2 results and discussed on the basis of multigroup calculations with different cross section sets. The results of this comparison show that most of the SNEAK 3A-2 data obtained at core center are reproduced with reasonable accuracy in the STARK experiment. 31 references. (auth)

37975 (GEAP–13762) SEFOR TRANSIENT FLUX DETECTION SYSTEM. Wittry, M. B.; Von Damm, C. A.; Neissel, J. P. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1971. Contract AT(04-3)-540. 55p. Dep. NTIS.

The transient flux detector system is designed to measure transient gamma radiation and neutron flux at several locations outside the SEFOR core. Because neutron detectors also measure gamma radiation, additional "gamma only" detectors are provided in a single unit with the neutron detectors so that the gamma signal can be subtracted from the combined neutron-gamma signal (gamma compensation), leaving a signal representing neutron level only. Design characteristics, circuit diagrams, and tests results for the transient flux detector system are presented. (4 references) (auth)

37976 (GEAP–13771-1) CRITICAL EXPERIMENTS AND COOPERATIVE EVALUATIONS PROGRAM. First Quarterly Report, October–December 1971. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1972. Contract AT-(04-3)-189. 37p. Dep. NTIS.

The ZPPR Assembly 3 configurations will simulate a control system of 19 control rods, each control rod with a nominal value of −$1.8. The assembly core will be a 2 enrichment zone core with a height of 36 inches. The critical configuration is estimated to contain 568 drawers (radius 76.0 cm) in zone 1 of which 48 simulate control and 552 drawers in zone 2 (radius 106.8 cm) of which 28 drawers simulate control. The experimental program is divided into 3 phases, where phases 1, 2, and 3 represent the end, middle, and beginning of an operating interval, respectively. Phases 1, 2, and 3 are designed to contain about 0, $10, and $20 of inserted control, respectively. Reactivity compensation of this inserted control will be accomplished by fuel spiking, i.e., replacing selected U_3O_8 plates with Pu-Al and Fe_2O_3 plates. The simulated control system will use B_4C as poison material. Each control position will occupy 4 matrix positions in a 2 × 2 array. The total B_4C required for ZPPR-3 is estimated to be 220 Kg. Analysis of control rod experiments in ZPPR-2 was used as a basis for normalization of the B_4C material requirements. Testing for ENDF/B, Version III was completed and the results sent to Brookhaven National Laboratory. A multi-group data set, based on ENDF/B-III, was obtained from HEDL. Conversion of the 1DX computer code to the GE-635 computer has been completed and checkout of the ETOX code on the GE-635 is continuing. ENDF/B-III data is being processed with the ENDRUN code into a 59-group file. This file will be used for ZPPR-III analyses. 7 references. (auth)

37977 (LFEN-NI–69-a) SARPI: FORTRAN IV PROGRAM FOR DETERMINATION OF THE MAXIMUM ADMISSIBLE POWER FOR THE PORTUGUESE RESEARCH REACTOR. Barros, A.; Comprido, A.; Leite, A. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1971. 27p. (In Portuguese). Dep. NTIS (U. S. Sales Only).

SARPI, a Fortran IV program for determination of the maximum admissible power for the Portuguese research reactor, is presented. The hypotheses used and the calculation scheme for the prediction of the water temperature at the outlet of the coolant tower, the thermal behavior of the exchanger, and the temperature distribution in the core are given and justified. The program instructions are listed and typical results are presented. (17 references) (J.S.R.)

37978 (NP–19266) TRANSMISSION METHOD FOR MEASUREMENT OF CENTRAL CAPTURE RATES IN FAST ZERO-POWER REACTORS. Kuhn, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Oct 1971. 84p. (In German). Dep. NTIS (U. S. Sales Only).

A special transmission method is described for determining experimentally central capture rates in fast zero-power reactors. In a general form the theory of an absorbing probe in a neutron field is derived using the idea of the path distribution function, p(s). In a further definition, a micropile is understood as a material probe of any form, which enters only single interactions with a neutron field. A formula for the effect of a micropile in a homogeneous isotropic field on a detector placed nearby is derived and the capture rate in the micropile can be obtained by using a grey detector. To approach a grey detector the fission cross sections of Pu-239, U-235, and U-234 were suitably combined. As an application of the method some measurements in the fast-thermal Argonaut reactor STARK were performed. 13 references. (auth)

37979 (RISO–256, pp 19-27) COLD-NEUTRON SOURCE IN THE DR 3. Leth, J. A. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.
In Aspects of research at Risoe.

A general description of the cold-neutron source in the DR 3 is given together with a short introduction to cold neutrons and the history of cold-neutron sources in reactors. The main difference between the DR 3 cold-neutron source and other cold sources is in the use of supercritical hydrogen as moderator, which permits adjustment of the effective hydrogen thickness by changing the temperature of the cryogenerators. 5 references. (auth)

37980 (RISO–256, pp 29-44) DEVELOPMENT OF NUCLEAR HEAT CALORIMETERS AND DOSE SEPARATION OF NUCLEAR HEAT COMPONENTS. Haack, Karsten (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.
In Aspects of research at Risoe.

The demand for information about the nuclear heating in samples and rigs in reactors necessitated the development of two types of calorimeters: (1) an adiabatic type (25 mm o.d.) with a sensitivity range of 1 to 500 mW/g for measurements in experimental facilities outside the core in the reflectors and (2) an isothermal rod type (6.5 mm o.d.) with a sensitivity range of 0.1 to 5 W/g for measurements in the fuel elements. A description of the calibration and measurement methods is given, and some characteristic results are shown. The dose separation comprises the calculations of the heat contributions from thermal and fast-neutron flux reactions in the calorimeter sample and structure. 4 references. (auth)

37981 (WASH–1510) FAST FLUX TEST FACILITY, RICHLAND, WASHINGTON. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). May 1972. 317p. Dep. NTIS.

The potential environmental impact of the proposed Fast Flux Test Facility to be located at the Hanford Reservation in Benton County, Washington, is evaluated. The evaluation included effects of chemical, thermal, and radioactive effluents, esthetic effects, safety considerations for the 400 MW(t) sodium cooled reactor, and a cost-benefit analysis. (128 references) (H.D.R.)

37982 GAMMA-RAY ENERGY SPECTRA OBSERVED AROUND A NUCLEAR REACTOR. Nakashima, Yoshiyuki (Nagoya Univ., Japan); Minato, Susumu; Kawano, Minoru; Tsujimoto, Tadashi; Katsurayama, Kousuke. J. Radiat. Res.; 12: No. 3-4, 138-47(Sep-Dec 1971).

Leakage γ-ray energy spectra up to about 9 MeV were measured by using of a $3'' \phi \times 3''$L NaI (Tl) scintillation counter at two points in the reactor room of KUR (Kyoto University Reactor), and leakage low energy γ-ray (between 10 and 200 keV) spectra were also measured at the reactor power of 5 MW by using a measuring system which consisted of a 25 mm $\phi \times$ 2 mm thick NaI (Tl) scintillation counter, a collimator, and a logarithmic amplifier. Distinct peaks were not found in the observed γ-ray energy spectra up to 9 MeV except zero power. In the case of zero power, the distributions in the spectra were not found in the energy range above 2.8 MeV. Peaks at the energies about 200 keV and between 60 and 100 keV were found in many low energy γ-ray spectra. The energy of the former peak corresponds nearly to single back-scattered γ-rays (scattering angle θ, 180°), and the latter one to multiple-scattered. The low energy γ-rays which leaked directly through the shielding wall of the reactor were observed below 30 keV. It was considered that low energy γ-rays leaked through the shielding wall were comparatively weak in intensity, and that high energy γ-rays, when leaked, became to low energy by scattering in the air. (4 references) (auth)

37983 MEASUREMENT OF FLOW PARAMETERS OF THE WATER IN A TANK REACTOR. Rasp, W.; Siegel, V. (Physikalisch-Technische Bundesanstalt, Brunswick). Kerntechnik; 14: No. 3, 123-8(Mar 1972). (In German and English).

High gamma radiation exposure rates above the open tank of a tank reactor can be avoided by appropriate guidance of the primary cooling recirculation flow above the reactor core. Measurements of the transport time of water from the vicinity of the core to the surface show that the saturation-activated short-lived radioactive nuclides ^{16}N, ^{17}N and ^{19}O reach the surface of the water with such a long delay that they contribute very little to the exposure rate above the tank. Measurements of the vertical distribution of the activity concentration in the water of the tank show that, despite intensive movement of the water in the lower part of the tank, the water near the top remains largely stagnant. (auth)

37984 EXPERIMENTAL EVALUATION OF THE RG-1M REACTOR FOR GEOLOGICAL RESEARCH. Alekseev, V. I.; Benevolenskii, A. M.; Kovalenko, V. V.; (and others). At. Energ. (USSR); 32: No. 4, 315-6(Apr 1972). (In Russian).

Start-up of the RG-1M reactor first occurred April 1970, using UO_2 (10% enrichment) at a power of 30 kW and moderated and cooled with water. Levels of neutron flux and γ-radiation were recorded in each of 10 experimental channels within the reactor. A large reserve of the reactor will permit a peak power of up to 100 or 120 kW without reloading its core. (K.S.W.)

37985 RESEARCH NUCLEAR REACTORS SKODA. Plzen, Czech.; Skoda ([1970]). 13p. (In Czech and English).

Design parameters are listed for the SR-OA Assembly, and the SR-I Reactor. (D.C.C.)

Production Reactors

Refer also to abstracts 36530, 36532, 36563, and 36565–36567.

Reactor Components, Fuels, and Accessories

Refer also to abstracts 36286, 36299, 36480, 36482, 36489, 36533, 36562, 36615, and 36618.

37986 (KFKI–72-21) RKVI: COMPUTER PROGRAM TO DETERMINE VIBRATION CHARACTERISTICS OF FUEL RODS IN PARALLEL FLOW. Szabados, L.; Kovacs, L. M. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Apr 1972. 24p. Dep. NTIS (U. S. Sales Only).

RKVI is a digital computer program for ICL-1905 computer in FORTRAN language. The code considers an isolated rod supported by two adjacent spacer grids, and calculates some important characteristics of rod vibrations induced by a single-phase fluid. These calculated parameters which are required for the engineering design of spacer grids can be summarized as follows: fundamental frequencies, maximum vibration amplitudes, end slopes, "end fixity" parameters, transverse deflection functions, transverse reaction forces, relative axial displacements and bending moment functions. 17 references. (auth)

37987 (RISO–256, pp 45-52) PELLET STACK SHORTENING AND CLADDING ELONGATION OF IRRADIATED UO_2–Zr FUEL PINS. List, F.; Knudsen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.
In Aspects of research at Risoe.

Six UO_2–Zr fuel pins irradiated to a burnup of 5,600 MWd/t UO_2 showed pellet stack shortenings of 5 to $8 \cdot 10^{-3}$ and pin elongations of 7 to $9 \cdot 10^{-4}$. A theoretical estimate, based on fuel-clad mechanical interaction and ratchetting, was made in an attempt to account for the length changes. The estimate for the pellet stack shortening agrees well with the observed values. The calculated pin elongation is lower than the measured values, probably because primary creep of Zr was neglected in the calculation. 7 references. (auth)

37988 BIMETALLIC SPACER GRID. (to Combustion Engineering, Inc.). British Patent 1,273,719. 10 May 1972. Priority date 27 Mar 1970, United States.

REACTOR FUEL ELEMENTS—spacer grid for, description of bimetallic (D.C.C.)

37989 FUEL ELEMENT BUNDLE FOR NUCLEAR REACTORS. Mueller, Richard Arno (to Gesellschaft fuer Kernforschung). U. S. Patent 3,658,646. 25 Apr 1972. Priority date 3 Apr 1966, Germany.

A fuel element bundle is described which has multiple rod-type fuel elements surrounded by a common shroud with coolant within the shroud surrounding the rods. The fuel elements are so constructed as to have eccentric portions which provide at least one helical path which offers lesser resistance to the flow of coolant among the rods. (auth)

37990 NUCLEAR REACTOR CONTAINMENT VESSEL WITH LEAK-TIGHT SERVICING SPACE. Thome, P. (to Commissariat a l'Energie Atomique). Canadian Patent 879,392. 24 Aug 1971. Priority date 26 Jan 1967, France.

The containment structure comprises a pressure vessel constructed of biological shielding material such as prestressed concrete, a leak-tight lining membrane which covers the internal face of the vessel, an impervious wall which is parallel to the lining membrane and a useful chamber enclosed within the wall. There is a servicing space between the wall and the lining membrane, a heat insulator removably fixed externally to the wall within the servicing space, and means for introducing a cooling and neutron-absorbing liquid within the servicing space. This liquid is maintained at a pressure of similar value to that which prevails within the chamber when it is at high pressure. Means for discharging the neutron absorbing liquid when the chamber is depressurized for servicing purposes completes the assembly around the side walls. In each end wall of the pressure vessel a removable seal plug provides access to the emptied space. (F.S.A.)

37991 IMPROVEMENTS IN OR RELATING TO THE SHUTTING-OFF OF PIPELINES. (to Siemens Aktiengesellschaft). British Patent 1,276,475. 1 Jun 1972. Priority date 13 Feb 1970, Germany.

REACTORS—cooling system for, description of pipeline shutoff valve for

VALVES—design characteristics of shutoff, for reactor cooling system pipelines (D.C.C.)

37992 NUCLEAR REACTOR CONTROL RODS AND DRIVE RODS THEREFOR. (to Siemens Aktiengesellschaft). British Patent 1,275,656. 24 May 1972. Priority date 7 Dec 1968, Germany.

REACTOR CONTROL ELEMENTS—drives for rod type, design characteristics of guides and latching systems for, (D.C.C.)

37993 NUCLEAR REACTOR FUEL-ROD CASINGS. (to Siemens Aktiengesellschaft). British Patent 1,275,223. 24 May 1972. Priority date 22 May 1969, Germany.

REACTOR FUEL ELEMENTS—cladding for, fabrication of end-sealed metal tube, (D.C.C.)

37994 NUCLEAR REACTOR CONTROL WITH REFLECTOR AND ABSORBER MEANS. Magladry, Robert E. (to Teledyne, Inc.). U. S. Patent 3,660,228. 2 May 1972. Filed 6 Nov 1967.

A nuclear reactor of the metal hydride control type is described. Metal hydride is in two portions, one in the core and the other external to the core, and means are provided for permitting flow of hydrogen between the two portions. Control of reactivity is obtained by providing heating means in one or both portions, the heating being responsive to a neutron sensor. (auth)

37995 MAGNETIC MONITORS FOR IN-PILE MEASUREMENTS OF MAXIMUM TEMPERATURE IN IRRADIATED SAMPLES. Stoelzl, D. (Univ., Karlsruhe, Ger.); Sizmann, R. J. Phys., E (London); 5: No. 6, 592-7(Jun 1972).

Magnetic probes are described for monitoring the maximum temperatures in samples irradiated in nuclear reactors. The specifications of the probes are: small size (25 mm × 1.5 mm wires), easy reading, dependable temperature indication to within a few degrees. The measuring range extends in principle from room temperature up to 1100°C. The reliability of the method is illustrated with in-pile measurements utilizing Ni–18.7 at. % Cu probes which cover the important range from room temperature to 130°C. (auth)

37996 DUAL-INPUT DESCRIBING FUNCTION IN THE OSCILLATION ANALYSIS OF A NUCLEAR REACTOR SYSTEM. Tan, Sevim (Middle East Technical Univ., Ankara). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 2, 327-33(Apr 1972).

The dual-input describing function concept is discussed with reference to a low-power nuclear reactor. Results of an earlier analysis, where the conventional describing function of a low-power nuclear reactor was derived by using the Wentzel–Kramers–Brillouin solution of the kinetics equations, are used to obtain the dual-input describing function of a low-power nuclear reactor. The dual-input describing function technique is applied to investigate the self-oscillations of a low-power nuclear reactor with external feedback. For a suitable frequency characteristic of the feedback, existence of an unstable limit-cycle is shown. (4 figures) (auth)

Reactor Physics and Core Engineering

Physics

Refer also to abstracts 36152 and 37976.

37997 (AEEW-M–1093) REVIEW OF THE STATUS OF COLLISION PROBABILITY METHODS. Askew, J. R. (Atomic Energy Establishment, Winfrith (England)). Jan 1972. 14p. (CONF-720104–2). Dep. NTIS (U. S. Sales Only).

From Seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972).

Methods for the calculation of collision probabilities are briefly reviewed with special emphasis on those for 2-dimensional geometries. An attempt is made to identify the key features of this integral representation of neutron transport which will have a bearing upon its performance relative to differential representations and hence the choice of solution techniques appropriate to particular classes of problems. 25 references. (auth)

37998 (AEEW-M–1094) SOME BOUNDARY CONDITION PROBLEMS ARISING IN THE APPLICATION OF COLLISION PROBABILITY METHODS. Askew, J. R. (Atomic Energy Establishment, Winfrith (England)). Jan 1972. 16p. (CONF-720104–3). Dep. NTIS (U. S. Sales Only).

From Seminar on numerical reactor calculations; Vienna, Austria (17 Jan 1972).

Two areas are described in which collision probabilities have profitably been used as an aid to the solution of problems in reactor models. The first of these is in obtaining a "snapshot" transport theory solution of a small zone of the reactor having some special complexity, without wishing to represent the whole reactor in comparable detail. The second is the use of "multicell" approximations to give a crude spatial modeling of a complicated reactor situation, especially useful where a good approximation to the multigroup spectrum is desired for subsequent energy condensation and more precise solution in few groups. (7 references) (auth)

37999 (ANCR–1051) MONA: A MULTIGROUP ONE-DIMENSIONAL NEUTRONICS ANALYSIS CODE. Putnam, G. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Mar 1972. Contract AT-(10-1)-1375. 124p. Dep. NTIS.

The MØNA program solves the multigroup one-dimensional diffusion equations for either the direct neutron flux or the adjoint (importance) function in slab, cylindrical, or spherical geometry. Homogeneous problems can be solved for the fundamental function and eigenvalue, or extraneous sources and sinks can be specified as group dependent boundary sources and/or group and space dependent volume sources and the inhomogeneous problem solved. Very general group dependent boundary conditions can be specified or the periodic condition can be imposed in slab problems. The usual power method (fission source iteration) is used and either two-point or Chebyshev extrapolation is optional for acceleration of convergence. All groups can be thermal (scattered into from lower groups) and optional inner iterations are allowed on them with several acceleration techniques available. Within each group, difference equations are solved simultaneously for the mesh point fluxes by Gaussian elimination of sub-diagonal elements and subsequent backsolution. There can be automatic searches on buckling, poison, region dimensions, region boundary position, atomic concentrations, or total fission source, with the last used to obtain quick solutions to problems with extraneous sources in near critical reactors. The diversity of output options allow edits of arbitrarily normalized group fluxes, fission source and power; flux spectra for regions and specified points, spatial distributions of median and average energies for the flux, fission rate, capture rate, and absorption rate; isotopic and material reaction rates by region; ratios of reaction rates; region dependent peak-to-average values for fluxes, source, and power; detailed neutron balance data; flux-weighted space and energy coalesced neutron group constants; and isotopic activation traverses. The MONA code operates on IBM 360 Series machines as an overlay program requiring about 300K bytes of core for program and input/output buffers. Variable dimensioning allows some trade-off among the mesh point, group, and region maxima. Running times vary from a few seconds for small problems to a few minutes with near maximum size, slowly convergent multithermal group problems. (auth)

38000 (CEA-N-1475) CONSISTENT FORMULATION OF THE HETEROGENEOUS THEORY IN THE DIPOLAR APPROXIMATION. Berna, Philippe (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Dec 1971. 413p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

Starting from a theorem established in transport theory, a new dipolar heterogeneous formulation is developed where channels are characterized by parameters depending on the environment only through cross sections. The formulas for these parameters can be calculated in less than 0.3 second (by channel type) on an IBM 360/91. The FODITH code based on this formulation gives an acceptable value for the experimental reactivity of a reactor having 3 narrow zones of different scattering properties (deviation lower than 200 pcm). The code gives results in better agreement with the experiment than other codes based on diffusion or source-sink theory. 41 references. (auth)

38001 (CEA-N-1509) ANALYSIS OF PROGRESSIVE REPLACEMENT EXPERIMENTS IN WHICH THE EXISTING LATTICE IS REPLACED BY ANOTHER MULTIPLYING LATTICE. Langlet, Gerard (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires); Reuss, Paul (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan 1972. 23p. (In French). Dep. NTIS (U. S. Sales Only).

Experiments of progressive replacement are widely used in France for the study of lattices of various reactor types. In this kind of experiment, the lattice to be studied is made to replace the center of a reference lattice, previously known. Resulting reactivity variations are then measured. The analysis is made by using the perturbation formula to the first order applied between calculation and experiment and not between the two lattices. Using the progressivity of the replacement, a very precise value of the difference in the deviations between real and calculated material bucklings in the substituted and the reference lattices is obtained. (auth)

38002 (EUR-4731) SPACE DEPENDENT REACTOR DYNAMICS. Proceedings of a Specialist Meeting on Reactivity Effects in Large Power Reactors, Ispra, Italy, October 28-31, 1970. (European Communities, Luxembourg. Commission). Feb 1972. 377p. (CONF-701019). EUR B. Fr. 500.-.

Included are 19 papers on methods for the analysis of space dependent dynamics of power reactors. A separate abstract was prepared for each of 14 papers. Three papers were previously abstracted for NSA and may be located under CEA-CONF-1684, CEA-CONF-1726, and TRG-Report-2060 in the Report Number Index. (H.D.R.)

For abstracts of individual papers see: 37806-37811, 38003-38009, and 38017.

38003 (EUR-4731, pp 55-71) MATHEMATICAL METHODS APPLICABLE TO SPACE TIME KINETICS. Werner, W. (Technische Hochschule, Munich (West Germany). Institut fuer Mess-Regelungstechnik). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

A comprehensive survey on mathematical methods applicable to space-time dependent neutron kinetics is presented. (auth)

38004 (EUR-4731, pp 143-8) ONE-DIMENSION NEUTRON DIFFUSION COMPUTER CODES, INCLUDING BOILING CHANNEL CALCULATION, FOR REACTOR DYNAMICS AND XENON TRANSIENTS ANALYSIS. Forti, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

Two computer codes for the dynamic analysis of boiling water reactors are briefly described. COSTAX-BOIL is used for the calculation of reactivity and coolant flow perturbation transients. The second code is used for calculating xenon transient effects during nonsteady-state operation. (H.D.R.)

38005 (EUR-4731, pp 149-70) SPACE DEPENDENT STUDIES OF TRANSIENTS IN HIGH TEMPERATURE REACTORS. Friedrich, K.; Massimo, L. (Brown Boveri/Krupp Reaktorbau G.m.b.H., Manheim (West Germany)); Vincenti, E. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

A one dimensional dynamics code for the analysis of transients in HTGR-type reactors is described. The code is based on the COSTANZA code and can be used for calculating the reactivity effects of water leakage into the primary cooling system, accidental control rod withdrawal, and coolant loss accidents. (H.D.R.)

38006 (EUR-4731, pp 171-80) ADVANTAGE OF SPATIAL TRANSIENT MODELS FOR THE DESIGN OF LARGE BWRs. Lockau, J.; Schmidt, U. (Allgemeine Elektricitaets-Gesellschaft Frankfurt am Main (West Germany). Kernenergieanlagen). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

Models for the analysis of fast and slow transients in boiling water reactors are briefly described. The dynamic behavior of the core during transients is analyzed with the COSTAX-BOIL and AXEMO codes and compared to measurements. (H.D.R.)

38007 (EUR-4731, pp 261-70) NEW METHOD TO CALCULATE SPACE-TIME KINETICS OF NUCLEAR REACTORS. Birkhofer, A.; Werner, W. (Technische Hochschule, Munich (West Germany). Institut fuer Mess- und Regelungstechnik). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

A two time level explicit method for calculating the space and time dependent kinetics in cylindrical geometry is described. (H.D.R.)

38008 (EUR-4731, pp 299-304) TWO-DIMENSION CODE COSTANZA (R, Z) FOR THE STUDY OF DYNAMIC TRANSIENTS, XENON OPERATIONAL TRANSIENTS AND XENON STABILITY. Vincenti, E. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

A short description of two codes is presented. One is used to calculate dynamic transients and the second is used for xenon operational transients and xenon stability calculations. (auth)

38009 (EUR-4731, pp 319-32) NUMERICAL SIMULATION OF XENON TRANSIENTS. Krug, H. (Technische Hochschule, Munich (West Germany). Institut fuer Mess- und Regelungstechnik). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

The effects of xenon transients on the spatial stability of large reactors are examined. The core situation of changing power and criticality is simulated by a numerical procedure. (H.D.R.)

38010 (EURFNR-944) APPROXIMATION OF THE STEADY-STATE, THREE-DIMENSIONAL MULTIGROUP NEUTRON DIFFUSION EQUATION BY A SYNTHESIS METHOD WITH THE KARLSRUHE SYNTHESIS PROGRAM KASY. Buckel, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Translation of report KFK-1349. 57p. Dep. NTIS.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Thesis. Submitted to Karlsruhe Univ., Ger.

The computer program KASY written in FORTRAN IV for the IBM 360/65 and larger models approximately solves the energy-group dependent three-dimensional neutron diffusion equation by a synthesis method. Catalogued two-dimensional trial functions are used for the calculation. A short description of the mathematical background of the variational principle used in the synthesis method is given. The contents and the structure of the programme KASY are explained. Some results are discussed. The results obtained by the programme KASY are compared with results from two-dimensional and three-dimensional fully numerical calculations. An extensive analysis of the Na cooled reactor Na2 with 5-, 12- and 26 group representation shows the possibilities and the limits of KASY. 21 references. (auth)

38011 (RISO-256, pp 7-17) DEVELOPMENT OF THREE-DIMENSIONAL CALCULATIONS IN REACTOR PHYSICS. EXPERIENCE WITH FLUX SYNTHESIS. Larsen, H.; Micheelsen, B. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1972.

In Aspects of research at Risoe.

Three-dimensional overall calculations of flux and power are necessary for detailed reactor calculations. The approximative flux synthesis method is fast and well suited for calculations of repetitive nature. A three-dimensional flux synthesis burnup program SYNTRON was developed. SYNTRON uses a variational, single-channel, flux synthesis technique. Calculations are performed with SYNTRON for comparison with a conventional difference equation program. 9 references. (auth)

38012 (WAPD-T-2427) MONTE CARLO EIGENFUNCTION UNCERTAINTIES. LWBR Development [Program]. Gast, R. C.; Candelore, N. R. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Mar 1972. Contract AT-11-GEN-14. 10p. (CONF-710606-18). Dep. NTIS.

From 17th annual meeting of the American Nuclear Society; Boston, Mass. (13 Jun 1971).

38013 NEUTRON TRANSPORT IN A DOUBLY-PERIODIC ARRAY OF ABSORBING MULTIPOLES. Aviram, Ira (Nuclear Research Centre-Negev, Beer-Sheva, Israel); Yeivin, Yehuda. J. Nucl. Energy; 26: No. 2, 61-74(Feb 1972).

Periodic solutions are derived for the one-velocity transport equation in an infinite two-dimensional lattice of absorption lines in a moderating medium. The unit cell of the lattice may be an arbitrary parallelogram so that the most common reactor lattices (square, hexagonal, triangular) are included as particular cases. Over the primitive cell, the angular flux is expanded in a double Fourier series whose coefficients are functions of the angular variable. The absorption lines are first treated as monopoles (total absorption being the only relevant quantity), then the formulation is extended to include a multipolar expansion of the distribution of absorptions in the fuel rod. Only quadrupole moments are retained in the expansion. The coefficients of the monopole and quadrupole terms should, in principle, be obtained from outside the model. It is shown, however, that quadrupole coefficients can be obtained directly from the monopole solution itself. Inclusion of the quadrupole terms in the solution improves the calculated flux profile for the fuel-moderator interface. (auth)

38014 NON-DESTRUCTIVE ABSOLUTE DETERMINATION OF THE ^{239}Pu CONTRIBUTION TO THE TOTAL FISSION ACTIVITY: EFFECT ON THE ACCURACY OF BURNUP DETERMINATIONS. Hiller, S. (Siemens AG, Erlangen, Ger.). Kerntechnik; 14: No. 3, 118-22(Mar 1972). (In German and English).

The measurement of the ratio of the activity of ^{106}Ru to that of another long-lived fission product nuclide offers the possibility of determining by non-destructive means the relative number of past fission events in ^{239}Pu and in uranium. The measurements were carried out by gamma spectrometry. In this manner, the respective contributions of the natural fuel, uranium, and of the bred ^{239}Pu to the total burnup of the most heavily loaded fuel rod M6 H2 of the KKN development program were determined. (auth)

38015 INTEGRAL COMPARISON THEOREMS AND THEIR APPLICATION TO NONLINEAR REACTOR DYNAMICS. Ziskind, Richard. Los Angeles; Univ. of California (1971). 150p. University Microfilms Order No. 72-2946.

Thesis.

The stability problem for nonlinear lumped and distributed parameter reactor systems is considered by using comparison theorems for Volterra integral equations. Starting with sets of ordinary or partial differential equations, functions which provide upper and lower bounds for the exact solutions are constructed. The interrelationships—between various parametric quantities, initial conditions, and eigenvalues related to the linearized equations—which guarantee the convergence of bounding functions to an equilibrium state of interest constitute the stability criteria and determine the stability domain for that state. For point models, a state variable formalism is adopted and the conversion to integral form is carried out utilizing the fundamental or state transition matrix. Semigroup theory is applied to the linear matrix operator of distributed models to determine if it serves as an infinitesimal generator of a semigroup of bounded, linear transformations. When this is the case, it follows that the solution of the system equations can be expressed in Volterra integral form. The integral comparison theory proved to be a practical method for investigating stability analysis. Comparison with exact solutions and alternate methods was undertaken for several types of chemical and nuclear reactor systems. The results are seen to produce stability domains comparable to other methods and exact results. (Diss. Abstr. Int., B)

38016 EFFECT OF RANDOMLY VARYING MACROSCOPIC PARAMETERS ON THE STABILITY OF POWER REACTORS. Krist, George Arthur Jr. Pittsburgh; Carnegie-Mellon Univ. (1971). 247p. University Microfilms Order No. 71-24,110.

Thesis.

An investigation of the stability of a nuclear power reactor subject to random macroscopic parameter variations is performed. A procedure based on a stochastic Lyapunov function is presented for the almost sure asymptotic stability of linear systems with randomly varying coefficients. An analysis procedure for determining the effect of stochastic coefficients on the stability in the mean and mean square of linear systems is presented. This procedure is based upon Gaussian white process variations which can be shown to be governed by the Fokker—Planck equation. Moment equations are extracted from the Fokker—Planck equation and serve as system equations used for the stability analysis. It is shown that for a simple space-independent reactor model it is possible for random macroscopic parameter variations to produce almost sure asymptotic instability in a deterministically stable system. A limitation of the almost sure asymptotic stability analysis is that it can be used only if the deterministic system is stable. The analysis procedure in the mean and mean square is employed in the investigation of the temperature stability problem for a linear space-independent reactor model and a coupled core spatial model utilized for the study of xenon instabilities. The results indicate that random macroscopic parameter variations in power reactors can act both as stabilizing or destabilizing influences. (Diss. Abstr. Int., B)

Core Thermal Hydraulics

38017 (EUR-4731, pp 197-9) DYNAMIC MODEL FOR THE DESCRIPTION OF THE THERMOHYDRAULIC OF OPEN CHANNELS WITH TWO PHASE COOLANT. Forti, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb 1972.

From CREST meeting on reactivity effects in large power reactors; Ispra, Italy (28 Oct 1970).

A model is described for predicting the occurrence of burnout conditions in hot channels during transients in water cooled reactors. (H.D.R.)

GENERAL

Civilian Defense

38018 (INDC(NDS)–40–U) INTERNATIONAL COOPERATION IN THE FIELD OF NUCLEAR DATA. Hjaerne, L.; Schmidt, J. J. (International Nuclear Data Committee). [1971]. 22p. (CONF-720117–1). Dep. NTIS (U. S. Sales Only).

From 22nd. national conference on nuclear spectroscopy and structure of the atomic nucleus; Kiev, USSR (25 Jan 1972).

This report reviews the objectives, achievements and future developments of the international cooperation in the field of nuclear data. Particular emphasis is given to the international compilation, exchange and review of neutron data important for the development of nuclear energy as a concerted effort of the four main world neutron data centers and to the role of the IAEA in this respect. More recently in response to various demands IAEA set up a modest program for nuclear structure and reaction data with the aim to promote and improve the international coordination of the dispersed efforts also in this field of nuclear data. (auth)

Law

Refer also to abstract 36470.

38019 (AERE-R–6912(Suppl.1)) HARWELL SUBROUTINE LIBRARY: A CATALOGUE OF SUBROUTINES (1971), SUPPLEMENT NO. 1. Hopper, M. J. (comp.) (Atomic Energy Research Establishment, Harwell (England)). Mar 1972. 24p. Dep. NTIS (U. S. Sales Only).

38020 (EUR–4773) SCIENTIFIC POLICY AND GOVERNMENTS. STUDY AND COMPARISON BETWEEN THE ROLE OF THE MEMBER COUNTRIES OF THE EUROPEAN COMMUNITY, THE UNITED KINGDOM, AND THE U.S.A. Gueben, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). 5 Jan 1972. 96p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 125,-.

Thesis.

38021 (LA-DC-72-389) THREE KOLMOGOROV–SMIRNOV-TYPE ONE-SAMPLE TESTS WITH IMPROVED POWER PROPERTIES. Lohrding, Ronald K. (Los Alamos Scientific Lab., N. Mex.). [1971]. 16p. (CONF-720427–1). Dep. NTIS.

From Joint statistical meeting; Des Moines, IA. (26 Apr 1972).

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Miscellaneous

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38025 (AECD/EL–11) BASIC ELEMENTS OF BINARY ANALYSIS. PART 1B. REALISATIONS OF BINARY FUNCTIONS. Khan, M. S. (Atomic Energy Centre, Dacca (Pakistan)). Sep 1971. 35p. Dep. NTIS (U. S. Sales Only).

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38027 (BMBW-FBK–72–4) INVESTIGATIONS OF THE MASS TRANSFER ON FREELY SUSPENDED SINGLE DROPLETS BY MEANS OF A MODIFIED LIQUID SCINTILLATION TECHNIQUE. Otto, W. (Technische Universitaet, Hanover (West Germany). Institut fuer Technische Chemie). Apr 1972. 74p. (In German). Dep. NTIS (U. S. Sales Only).

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Eighteen papers are included, and a separate abstract was prepared for each of the thirteen papers in scope for NSA. (L.M.T.)

For abstracts of individual papers see: 35762, 35833, 35891, 36273, 36468, 36469, 36619, 37735, 37767, 37979, 37980, 37987, and 38011.

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Germanic	ä appears as	ae
Germanic	ö	oe
Germanic	ü	ue
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The reader is also referred to *Guide to Abstracting and Indexing for Nuclear Science Abstracts* (USAEC report TID-4576).

Most headings in the subject index are the names of specific materials, things, and processes. Each heading is followed by a modifier that describes the properties of, or processes applied to, that heading.

All index entries cite *NSA* volume and abstract numbers; volume number precedes the colon and the abstract number follows it. The designation (R) following the abstract number indicates a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Report numbers, where applicable, are included in parentheses after the abstract number of the citation. Published literature (journal article or book) can be identified by the absence of a report number.

Ideas presented in the original literature, rather than key words, have been indexed. The indexers have selected what seemed the most probable and logical place to look for typical information. Since it is not always possible to anticipate where a user would look for information, the cumulative indexes include numerous cross references. Consideration of synonymous or closely related terms will prove valuable.

Information is indexed for the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use or to the general class headings that include the specific headings. For example, information on boiler design for the Fermi Fast Breeder Reactor would be indexed under the headings BOILERS and FERMI FAST BREEDER REACTOR but not necessarily under the headings REACTORS, FAST or REACTORS, BREEDER.

General or broad headings are reserved for general summaries, reviews, comprehensive reports, and similar literature.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings; e.g., AMINO ACIDS rather than ACIDS, AMINO; HELIUM ISOTOPES He-4 rather than HELIUM—ISOTOPES He-4 or HELIUM—He-4 ISOTOPES. Note, however, that in some cases parenthetic modifying terms or inverted headings such as NEUTRONS, FAST, are used where the alphabetical arrangement of a direct entry would cause information to be scattered. In addition, organic compounds are usually entered in the index in the inverted form to facilitate grouping like or related compounds with the parent compounds; e.g., BENZENE, BROMO- rather than BROMOBENZENE.

Alphabetization

Subject headings are alphabetized word by word. Parenthetic qualifiers, numbers, and Greek letters within subject headings are disregarded in alphabetizing unless there are two or more headings that are otherwise identical, in which case the qualifier, numerical progression, or spelled names for the Greek letters determine the order.

Examples:

M-Capture
  see ELECTRON CAPTURE
MAGNESIUM
MAGNESIUM ALLOYS AND SYSTEMS
MESONS
MESONS (π)
MESONS (rho)
1-PENTANOL
2-PENTANOL
URANIUM OXIDES
URANIUM OXIDES UO_2

Modifying Phrases

The modifiers appearing under a subject heading are written specifically to show the relation between the item being indexed and the heading. The modifier therefore contains a maximum of useful information. Although the modifier begins with the word judged to be of greatest use to the greatest number of users, there is still need for the searcher to consider all modifiers under the heading(s) of interest.

Modifiers usually form meaningful phrases when combined with the subject heading. Some are intended to be read following the subject heading, e.g., the entry HYDROGEN—*sorption by charcoal,* should be read *hydrogen sorption by charcoal.* As a result of placing the important word first, however, many modifiers must be rearranged for smooth reading, e.g., FORMALDEHYDE—*yields in radiolysis of ethyl ether, effects of deuterium on,* should be read *effects of deuterium on formaldehyde yields in radiolysis of ethyl ether* and URANIUM—*crystal structure of, effect of cooling rate on allotropic transformations in,* should be read *effect of cooling rate on allotropic transformations in crystal structure of uranium.*

Special characters are added to modifiers in the fields of physics and reactor technology; if the modifier does not establish the experimental or theoretical character of a reference, a symbol (E), (T), or (E/T) is placed immediately after the modifying phrase and before the abstract number.

Physical States and Configurations of Materials

The specific physical state, if other than normal, or the geometric configuration of the material is included in the modifying phrase; e.g., information on liquid metals is indexed under the specific metal with "liquid" in the modifier and carbon crucibles is indexed under CARBON with "crucibles" appropriately placed in the modifier. The information on carbon crucibles is also indexed under CRUCIBLES.

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed to subject headings in the direct form. Cations are listed in the order of increasing valence for polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., SODIUM ALUMINUM SILICATES and POTASSIUM SODIUM SULFATES. If more than one anionic species is presented in a compound, the anions are arranged alphabetically, e.g., BERYLLIUM FLUORIDE HYDROXIDES.

Nomenclature of Organic Compounds

Complex organic compounds occur in such variety as to require a systematic nomenclature. Headings for most substituted organic compounds are found in an inverted form following names of the parent compounds. Examples of two such headings are:

```
2,4-HEPTANEDIONE
2,4-HEPTANEDIONE, 1-PHENYL-
```

Headings are included for broad class names of enzymes, e.g., HYDROLASES and TRANSFERASES. Specific enzyme names are to be found in modifiers under these headings. Similarly, broad class names for hormones are included as headings, except in this case the headings are entered in the inverted form as, e.g., HORMONES, ADRENAL and HORMONES, SEX. The more specific names of hormones are to be found in the modifiers under the appropriate broad headings.

For compounds used as drugs, an effort is made to use subject headings that reflect the recommendations of the USAN (United States Adopted Names) compilation or the "New Names" columns of the *Journal of the American Medical Association.* The *Merck Index* has also been used in selecting subject headings for drugs.

Nomenclature of Life Sciences

Except for those in the phylum Tracheophyta, subject headings for plants are common names. For example, ALGAE, FUNGI, SLIME MOLDS, MOSSES, and LIVERWORTS are subject headings. The phylum name TRACHEOPHYTA and several classes and subclasses belonging to it are entered as subject headings. The specific classes entered are PSILOPSIDA, LYCOPSIDA, SPHENOPSIDA, and PTEROPSIDA. The three subclasses FILICINIDAE, GYMNOSPERMIDAE, and ANGIOSPERMIDAE which belong under Pteropsida are also subject headings. Scientific names (genus and species) and common names if known are used in the modifying phrase.

Subject headings for microorganisms are VIRUSES, RICKETTSIA, and BACTERIA. The name of the type or kind of virus or the genus and species names of the organisms should appear in the modifying phrase.

The names of animal phyla are subject headings. The arthropods are also indexed to subject headings for classes INSECTA, CRUSTACEA, ARACHNIDA, DIPLOPODA, and CHILOPODA. The invertebrate chordates are indexed to subject headings UROCHORDATA and CEPHALOCHORDATA. The vertebrates are indexed to headings for the classes AGNATHA, CHONDRICHTHYES, OSTEICHTHYES, AMPHIBIA, REPTILIA, AVES, and MAMMALIA as well as to the general heading VERTEBRATA. Common names are used as subject headings in the class Mammalia.

Subject headings are entered for various classes of commodities, and specific products are identified in the file-word position of the modifier. In the following examples, approved subject headings are capitalized and typical modifier file words are listed in lower case.

Example 1	Example 2
CEREALS	MEATS
bread	beef
flour	fish
oats	mutton
rice	pork
rye	poultry
wheat	seafood

Diseases, pathological conditions, and in vitro studies of atypical cells and tissues are indexed under subject headings for the organism affected, under the appropriate anatomical structure of physiological phenomenon affected, and under the appropriate disease heading. Subject headings for diseases (defined as any deviation from the norm) are common names such as ANEMIA, FIBROSIS, INFECTIONS, LEUKEMIA, NEOPLASMS, and RADIATION SICKNESS. Also, the general headings DISEASES and DISEASES, PLANTS are available as subject headings.

Multicomponent Alloys and Other Systems

Multicomponent alloys and systems, except those with well-known trade names, are indexed under a subject heading for each component in the form "element systems" for nonmetals or "element alloys and systems" for metals. The modifier begins with element symbols for each component arranged alphabetically. In addition, if significance is placed on the base metal of the alloy, this is indicated by adding "-base" to the element symbol.

Example: A 1.5C, 12Cr, 0.25V, 0.8Mo, bal Fe alloy is indexed as

```
CARBON SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
CHROMIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
IRON ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
MOLYBDENUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
VANADIUM ALLOYS AND SYSTEMS
  C--Cr--Fe-base--Mo--V, ...
```

Well-known alloys, such as ZIRCALOY-2, are indexed under the trade name; cross references from each component of the alloy to the trade name appear in cumulative indexes.

Multicomponent systems in which nonmetallic elements are present in large percentage and which are commonly referred to as systems or mixtures are indexed in a manner similar to alloys.

Example: A tungsten–silicon preparation is indexed as

```
TUNGSTEN ALLOYS AND SYSTEMS
  Si--W, ...
SILICON SYSTEMS
  Si--W, ...
```

Multicompound systems and mixtures of inorganic compounds are indexed under the subject heading for each component compound; the modifiers begin with an alphabetical listing of compound formulas.

Example: A lead titanate–lead zirconate mixture is indexed as

LEAD TITANATES
  $PbTiO_3$--$PbZrO_3$
LEAD ZIRCONATES
  $PbTiO_3$--$PbZrO_3$

Mixtures of organic compounds are indexed under subject headings for each component of the mixture; the modifiers begin with an alphabetical listing of compound names.

Example:

ACETIC ACID
  acetic acid--BF_3, ...
BORON FLUORIDES
  acetic acid--BF_3, ...

Example:

BENZENE, CHLORO-
  bromophenol--chlorobenzene, ...
PHENOL, BROMO-
  bromophenol--chlorobenzene, ...

A mixed system of compounds and elements is indexed by a combined form of the preceding conventions; e.g., a dispersion of copper and alumina would be indexed as

ALUMINUM OXIDES
  Al_2O_3--Cu, ...
COPPER ALLOYS AND SYSTEMS
  Al_2O_3--Cu, ...

If modifiers for alloys and systems are included with other modifiers under the same subject heading, they are filed last.

Example:

CARBON SYSTEMS
  deposition on nuclear fuel particles
  molecular structure of
  neutron total cross section for
  sorptive properties for xenon
  Young's modulus for
  Al--C--Cr, superconductivity in
  B--C, phase studies for
  C--U--Zr, fabrication and physical properties of

Nomenclature of High Energy Physics

Information on particle-particle events is indexed under subject headings for the specific particles involved. The modifier file word *interactions* is followed by the specific interaction written in symbolic form. Particle nomenclature and symbols follow that of the Particle Data Group published in *Review of Particle Properties* (latest revision). For consistency the incident particle is always written first. The mass (in MeV) of a resonance state is included in parentheses after the symbol to avoid ambiguity. Hyperfragments are indicated in modifiers as in the following examples: Λ-He^5, Σ-H^3, $\Lambda\Lambda$-Be^{10}. The superscript on the right indicates the total number of baryons in the composite system.

Examples:

MESONS (π^-)
  interactions $\pi^- + p \to \Lambda + K^+ + \pi^-$ at 6 GeV/c in hydrogen bubble chamber, $\Lambda K(1700)$ enhancement in, (E)
BARYONS, RESONANCE (Δ)
  production of $\Delta^{++}(1236)$ and $\Delta^0(1236)$ from $K^- + p \to K^- + p + \pi^+ + \pi^-$ interactions at 2.63 and 2.70 GeV/c, (E)
HYPERNUCLEI
  binding energy of $\Lambda\Lambda$-He^6, three-body α--Λ--Λ model for

Subject headings are also provided for specific models and theories.

Examples:

ELEMENTARY PARTICLE MODELS
  quark, hadron total cross sections in, numerical analysis of
CURRENT ALGEBRA
  PCAC hypothesis for A_1 and rho dominance in $\pi \to e + \nu + \gamma$ decay
REGGE POLE THEORY
  predictions for polarization in $K^- + p \to$ anti $K^0 + n$, $\pi^- + p \to \pi^0 + n$, and $\pi^- + p \to$ eta + n interactions at high energies
SYMMETRY GROUPS
  SU(2) x SU(4) intermediate-coupling model for nucleon and hyperon isobars

Nomenclature of Reactor Technology

Subject headings for reactors are of three types:

(1) Specific reactors, e.g., ARGONNE RESEARCH REACTOR, SAXTON POWER REACTOR

(2) Reactors having a common physics or engineering characteristic, e.g., REACTORS, FAST; REACTORS, ORGANIC-COOLED; REACTORS, PRESSURIZED-WATER

(3) Reactors having a common purpose, e.g., REACTORS, POWER; REACTORS, RESEARCH

Information on specific reactors, type (1), is indexed under the one specific subject heading. Information on classes or types of reactors, types (2) (characteristics) and (3) (purpose), is indexed under all applicable headings. For example, information on a heavy-water-moderated organic-cooled power reactor is indexed under REACTORS, HEAVY WATER-MODERATED; REACTORS, ORGANIC-COOLED; and REACTORS, POWER.

Subject headings exist for selected reactor components, e.g., REACTOR FUEL ELEMENTS. When applicable, headings for components are indexed even though they may have been included in a modifier under a type (2) or (3) heading. The materials in reactor components are indexed when the information is peculiar to the material.

Modifier file words under reactor headings are of two primary types: one type expresses reactor characteristics, e.g., reactivity; the other, components, e.g., control rod. If no subject heading appears for a reactor component, the heading REACTORS is used, and the component is used as the modifier file word.

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	26-36538	Houston, Tex.; National Association of Corrosion Engineers (1972). 842p
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CONF-700573-	(Symposium on The Training of Radiologic Administrators, Cincinnati, OH., May 22, 1970)	
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